# A RISK ANALYSIS OF FARMERS IN MEXICO: PRICES, RISK RATIONING AND CONFLICT

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# A RISK ANALYSIS OF FARMERS IN MEXICO: PRICES, RISK RATIONING AND CONFLICT

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Farming is, by its own nature, a risky enterprise. Farmers are subject to many exogenous risks, for instance, price and production volatility, and credit default risk. Although there exists insurance products that help mitigate these types of risks, most of them are offered in developed countries. Farmers in developing countries, in general, lack the financial instruments to cope with production uncertainty. Mexican farmers are no exception. Mexican farmers face multiple risks that have been largely understudied. Some of these risks are common to farmers in developed as well as in other developing countries, but a few of them are unique to Mexico due to its current state of events.

The overall objective of this dissertation is to investigate risks faced by Mexican farmers. The specific objectives are: to provide a basic understanding of Mexican agriculture and the risks they face from production and markets; to investigate mechanisms for price risk management for Mexican farmers; to investigate the relationship between risk rationing and credit demand; and to investigate the impact of narcoterrorism on agriculture and rural life.

This dissertation provides alternatives for risk management and new insights for understanding Mexican farmers' risks. These alternative solutions and analysis are based on financial engineering theory; on a novel approach to risk rationing; on the dual process and the ecological psychology theories to understand fear and risk perception.

## BIOGRAPHICAL SKETCH

Leslie J. Verteramo Chiu received his B.A. in International Business and Economics from Sophia University, in Tokyo, Japan in 1998. Following his B.A., he worked at the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Campus Tampico, where he completed his M.Eng. in Quality and Productivity in 2001.

Being in close contact with the agricultural sector all his life led him to developed his interest in the field of agricultural economics.

He joined the Department of Applied Economics and Management of Cornell University in 2006 as a graduate student. While in Cornell University, he worked with Profs. Calum Turvey and Miguel I. Gomez, who later became their committee members, on several projects related to agricultural finance and development. He also worked with Profs. Todd Schmit and William Tomek.

In 2009 he received a three-year scholarship for Ph.D. studies from the National Council of Science and Technology of Mexico (CONACYT).

Leslie's research interests includes agricultural finance, specially in developing countries; risk analysis and hedging mechanisms; price analysis; behavioral and experimental economics; and conflict and risk perception.

A mi Padre y Madre.

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My parents and brother provided invaluable support, for which I will forever be grateful; also, Jennifer and Maria gave me so much needed motivation for working hard and looking forward.

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# CHAPTER 1

# INTRODUCTION

Farming is, by its own nature, a risky enterprise. Farmers are subject to many exogenous risks, for instance, price and production volatility, and credit default risk. Although there exists insurance products that help mitigate these types of risks, most of them are offered in developed countries. Farmers in developing countries, in general, lack the financial instruments to cope with production uncertainty. Mexican farmers are no exception.

Mexican farmers face multiple risks that have been largely understudied. Some of these risks are common to farmers in developed as well as in other developing countries, but a few of them are unique to Mexico due to its current state of events.

As an illustration of common risks, in most countries farmers make their planting decisions under harvest price uncertainty.  While some financial tools exist for eliminating price risk, not all farmers, particularly in developing countries, have access to them. Crop yield is also subject to risk, which depends on endogenous factors like farmers' experience and resources, and on exogenous factors like weather, which unpredictable characteristic creates a major burden on yield. These risk factors can be mitigated trough insurance products where available. These risks are known to the farmers through personal experience, or through learning from other sources. They asses those risks based on historical probability, and make their appropriate decisions accordingly. We say that farmers behave objectively if their risk assessment on an even is the same as the historical probability or obtained from an official, or expert, source. There are, however, some risks in which producers do not have enough information to form an objective probability assessment; or, if that information exists, their assessment does not correspond to that of historical probability or expert sources. That is, if information about a risk exists, farmers' assessment on that risk would be different from what the objective assessment is. We say that these farmers behave under a subjective probability of risk. Subjective probability exists if farmers not having enough information, or data, of an event, estimate the probability of that event; or if they have empirical (historical) data of an event, they disregard them and instead create their own personal probability. Subjective risk assessment can be very different from the objective one. If the difference is too large, a producer would be reluctant to take a risk even though the actual probability of a risky event happening m may be very low. Subjective assessment of risk can exaggerate risk perception and create a behavior that does not correspond to the economic paradigm of utility maximization.

An example where subjective risk is much larger than objective risk is the concept of risk rationing. Risk rationing can be explained as the voluntary refraining from participating in the credit market because the risk associated with the potential collateral loss is too large. In other words, farmers who are risk rationed would not request a loan to increase production, even though this would create higher expected income, because they fear losing their collateral. Risk rationed farmers would stay in a low income-low risk activity, even though they have access to credit and the capacity needed to generate higher income. This subjective risk restricts farmers to a low income state. Some types of farm insurance can help farmers engage into the high income activity, but again, they may not be available in all countries. Another instance where subjective risk affects changes in producer's behavior is social and political instability. The recent events of violence in Mexico, product of the narco war, lead us to inquire into their effects on agricultural production and rural life. It is undeniable that living in a violent environment, similar to what is happening in some parts of Mexico, affect people's daily activities. It is surprising that there are not many studies on the effects of narco violence on agricultural production and rural life. This source of agricultural risk is particular to Mexico at the present time; here, social psychology intersects with economy. Of course, many other countries have gone through periods of generalized violence and insecurity, but for the case of Mexico the number of kidnapping, carjacking, and homicides have increased dramatically affecting people that have never experience this type of crimes.

How risks are perceived is widely debated. The model used in chapter 3 is an ontological approach to risk. Given known properties of probabilities, we can and do construct a model from first principles and that data is treated as given. This is consistent with Knight's view of risk and objective distributions. Whether events will conspire from multiple sources to remove collateral is a different matter. Farmers facing near identical circumstances will view risks through different lenses. The alterability of actions is largely cognitive and based on perceptions of risk which are largely subjective. Even more so to acts of terrorism, in which affect depends on the environment. People respond to the stimuli of their environment, and those stimuli are processes different depending on each individual characteristics and personal experiences.

The way farmers process information related to agricultural and other risks can result in different types of behavior related to production and daily life. A description of various risk factors faced by Mexican farmers is provided next along with our proposed analysis.

Statement of Objectives

The overall objective of this dissertation is to investigate risks faced by Mexican farmers. The specific objectives are:

1. To provide a basic understanding of Mexican agriculture and the risks they face from production and markets.

   To achieve this objective, in chapter 2 we summarize key metrics of production, demographics, risk factors and perceptions obtained from a field survey of 370 farmers in the northeastern Huasteca region. Through this survey, we are able to understand the income characteristics of the farmers, how they diversify risk, willingness to adopt new technologies and take risks, and perception of insecurity caused by narcos. We also measured the willingness to pay for risk contingent credit, currently unavailable, which can increase participation in the credit market even for risk rationed individuals.

2. To investigate mechanisms for price risk management for Mexican farmers.

To achieve this objective, in chapter 3 we applied a financial engineering product called quanto to estimate option prices for the main commodities grown in the study region. We use secondary data at various locations to estimate the quantos prices. By incorporating futures, exchange rate and local basis risk, we came up with put (and call) prices for three different commodities at various locations in Mexico. This model, by taking into account all risk factors that affect local prices, provides a more complete model for price insurance than one that just looks into exchange rate and futures price risk. We also show that this model can be expanded to many other commodities as long as local prices are correlated to a futures price in a commodities exchange, and also that there are no exchange rate restrictions.

3. To investigate the relationship between risk rationing and credit demand.

   To achieve this objective, we provide two non-mutually exclusive investigations. The first, in chapter 4, examines the results of two farm surveys, in Mexico and China, which serve as empirical test and evidence of risk rationing according to the current definition. The second investigation, in chapter 5, provides an alternative theoretical model for risk rationing and validates it using field data. We provide a more general interpretation of risk rationing, and investigate the mechanisms to include risk rationed producers into the credit market.

4. To investigate the impact of narcoterrorism on agriculture and rural life.

    To achieve this objective, in chapter 6 we investigate, using field surveys, the violence perception and fear level on several dimensions of farmers living in a conflict area where narco violence is a new phenomenon. We used methods and theories from psychology to investigate the effects of widespread violence on small scale farmers; specifically, we look on the changes of daily life and rural community dynamics.

The remainder of this chapter expands on these ideas.

It is important to mention that although all analysis described previously are related to the same topic, Mexican farmers' risks, each chapter is self-contained in a given topic and can be read on its own without the need to read earlier chapters. For this reason, the reader may find that two or more chapters have redundant elements. I justify these redundancies partly because they are incorporated in the context of each chapter, and partly for the reason of self-containment described above.

Chapter 2 provides a summary of our Mexican farmers' survey. These results give a clear picture on the background of the farmers in our area of study. This chapter provides a summary of the characteristics of the farmers under this study. Demographic, production and lifestyle information are captured through a survey conducted in 2011. The region of our study was chosen for three main reasons. First, many people there live off agriculture and complement their income with other productive activities. Most of these farmers are small landowners that have the choice of planting among three crops. Therefore, it provides an opportunity to analyze crop choice. Second, we have a working relationship with a local producers' association, Interagro de las Huastecas, S.A. de C.V. (Interagro). Through the help of Interagro, the survey was completed without any problem in a short time. Our local partner provided logistic support, sampling selection and enumerators. Last, when this research took place, the region was going through a period of insecurity caused by the presence of drug cartels (narcos) and its consequent criminal activities. Such criminal activities and the presence of narcos, army and navy were new phenomena for local people. This provides the opportunity to estimate how much this new type of risk is perceived and how much it affects rural life and agricultural production. Although Mexico has national statistics about rural communities, they are not design to capture risk perception and actions, and the frequency of them is too far apart. The results presented in this chapter provide a deeper understanding of small scale farmers and their activities at a time where safety conditions have changed.

Chapter 3 investigates and provides a solution to commodity price risk faced by Mexican farmers. Commodity price insurance products are easily available to farmers in developed countries. For instance, institutional futures markets provide agricultural producers and buyers with financial derivatives to hedge against price uncertainty. Corn farmers in the US have access to futures and options contracts through the Chicago Mercantile Exchange (CME). The exchange provides price disclosure and standardized contracts, which facilitates commercial operations. However, in most developing countries, with no organized futures exchange, producers and buyers do not have direct access to these types of products. In its World Development Report of 2005, The World Bank acknowledged the importance of reducing price risk as a priority for economic development. Among the policy options described in the report to manage risk, the main ones are the piloting and adoption of market-based risk management instruments; and the creation of countercyclical safety nets for poor farmers (World Bank, 2005). However, in most instances the market instruments required is a derivative of a security (e.g. futures contract) denominated in a currency that differs from the target client. For instance, the Mexican government through a marketing program buys options at a futures market in the US in order to hedge farmers and buyers positions. Using US wheat futures and options contracts are analyzed as a hedging strategy in Pakistan (Faruqee, Coleman and Scott,1977) . Thus, not only is basis and price risk critical elements but also important is foreign exchange rate.

The burden of mispricing publicly provided risk management ultimately rests with either the farmers whom are to be the beneficiaries (if the price is too high) or tax payers (if the price is too low), and without computational guidance this can become costly. In order to fulfill programs such as discussed in the World Bank report, techniques are required to properly price risk on a probabilistic basis. Policy makers must take into account not only the price risk of the foreign security, but swings in exchange rates and local basis. This requires a unique approach and the purpose of this paper is to describe and illustrate the pricing mechanism on an actuarial basis using options theory. This chapter addresses the two policy priorities outlined by the World Bank by illustrating how futures price, basis and foreign exchange affect local cash prices and its derivatives. These two policy priorities can be met by means of the market-based quanto (Quantity Adjusting Option) pricing mechanism described in this thesis.

The subject matter of this analysis deals with the price protection of grains in Mexico. Problems faced by Mexican farmers are typical of the problems faced by producers of the World Bank target countries. In general, they lack the financial infrastructure needed to insure their crops, like institutional futures markets or over-the-counter (OTC) markets. How we deal with the Mexican case lays out some fundamental strategies that can be scaled up or down to address similar issues in other developing agricultural economies where price risk is largely determined offshore, that is, from futures markets that affect local prices, and the foreign exchange rate.

In Mexico, the most common way for grain producers to hedge price risk is by participating into a government sponsored forward contracts called *Agricultura por Contrato*. Under this program, contract prices at various local markets are reached through negotiations between producers and buyers, mediated by the government. Local prices are calculated by adding to the closest futures price contract quoted at the CME transportation, storage and financial costs to commodities at relevant port of entry. Depending on the distance to these ports, the basis for each local market is calculated. The price at each port of entry is also calculated on the futures price at the CME plus local basis, which are published and thus publicly available in the US.

Although the benefits of price guaranteed programs, like *Agricultura por Contrato* are evident, there are also problems in its reach. The program subsidizes any contract cost to both parties and provides a guarantee against counterparty default.

Farmers are not subject to basis risk under this scheme; any price movement against the farmer is covered by the government. Nevertheless, the requirements for producers to be part of the program can be overwhelming and consequently some producers may not meet the criteria. Because this program is not market driven but politically motivated, the success of it depends on its assigned budget. There are times when farmers are left out due to lack of funding (Echánove, 2011). Excluded farmers may engage into forward contracts directly with large grain buyers and processors, but without government sponsorship these contracts are subject to default risk. Also, not all grain contracts in México are supported through this program. Our proposed model is a market-based alternative for price insurance; which unlike government insurance programs are not subject to assigned budgets or other selection criteria.

Chapter 4 of this thesis looks at the current definition of risk rationing and compares it to our survey results for Mexican farmers. A contemporaneous and similar survey of Chinese farmers by Vararuth (2012)[1] was also included in our analysis to complement and further understand and test the conditions for risk rationing. This section gives the foundation for understanding this concept and the incidence in two culturally different countries.

In this analysis, we provide a specific test of the Boucher, Carter and Guirkinger (2008) (BCG) framework to determine the extent of risk rationing amongst potential rural borrowers. Using data from 372 farmers in northeastern Mexico and complementing the results with 730 farm households in the Shaanxi

[1] Vararuth's (2012) survey was conducted independently of this thesis research. However, once the Mexican data was collected, it was decided that the results should be combined into a single document. This document is provided in chapter 4.

province of China, we investigate factors associated with risk rationed, quantity rationed and price rationed farmers. The analysis applies both a linear probability and logit model. We find that in Mexico 35% of our sample is risk rationed, 10% quantity rationed and 55% price rationed; while in China, the incidence of risk rationing in farmers to be 6.5%, 14% for quantity rationed and 80% for price rationed. Results from Mexico indicate that the level of education is important in determining quantity rationing; and the results from China support the hypothesis that financial poor are more likely to be quantity rationed. In both countries, asset wealthy farmers are less likely to be risk rationed; however, income doesn't appear to have an impact. We provide evidence that the elasticity of demand for credit is different among the three groups of farmers: risk rationed, quantity rationed and price rationed. In Mexico, risk aversion is correlated with being risk rationed; while in China prudence is also significantly correlated with risk rationing. Our results suggest that efforts to enhance credit access must also deal with risk and risk perceptions**.** With some exceptions, our investigation supports the theoretical model presented in Boucher, Carter and Guirkinger (2008).

The concept of risk rationing rounds out the various sources of credit constraints that include quantity and price rationing. Quantity rationed are defined as those individuals who are not offered credit, either their credit is not approved or they refrain from requesting it for they believe they do not qualify. Price rationed are those individuals who qualify for, and are offered credit. When considered in full, supply side quantity and price rationing and demand side price and risk rationing round out all possible factors that might give rise to a positive shadow price on a farm household's credit constraint. At the heart of risk rationing is the partitioning of non-borrowers into those that do not borrow because of collateral risk and those that do not borrow because of they have no need. Guirkinger and Boucher (2008) develop a model and show that collateral requirements imposed by lenders in response to asymmetric information can cause not only quantity rationing but also transaction cost rationing and risk rationing. In a related work Boucher, Guirkinger, and Trivelli (2009) used survey data from Peru to measure the incidence and impact of credit constraints in the formal credit sector. They find that risk rationed households account for a significant fraction of the sample as indicated above. They also provide examples of responses associated with risk rationing. Of these, the most common response in each of the surveys they conducted was "I don't want to risk my land".

We believe risk rationing, as a topic of inquiry, is critically important in understanding borrower behavior and credit decisions in agricultural development, and find the models presented in BCG intriguing from the points of view of academic completeness and public policy guidance. Our surveys were instrumented to specifically test the conjectures and hypotheses of BCG and to examine further endogenous relationships that might prove important to a deeper understanding of risk rationing. Our approach uses the direct elicitation methodology (DEM), where a set of questions directly elicits the household's status as either credit constrained versus unconstrained, and is similar to an approach recommended in Boucher, Guirkinger and Trivellini (2009). Endogenous characteristics that we estimate econometrically include credit demand and credit demand elasticities, informal lending, property rights, entrepreneurship, risk aversion, prudence, wealth, insurance markets and asymmetric information.

Chapter 5 provides a different optic to understand risk rationing. Based on the results from our field studies and from the current definition of risk rationing, I create a more general definition which I test and validate empirically. This new definition provides a clear understanding of what makes people risk rationed, and also provides suggestions on policy implications to move farmers out of the risk rationing state.

I present a utility model of a risk rationed individual as defined by Boucher (2008), and illustrate the effects of higher moments in the utility function and the relationship with the risk aversion, prudence and downside risk aversion coefficients.

The term Risk Rationed describes an individual that having the asset wealth to qualify for a credit, voluntarily refrains from it for fear of losing his collateral. This consideration of preserving wealth by means of minimizing the probability of falling below a threshold income level was first analyzed by Roy (1952). His Safety First model became the precursor of the Sharpe Ratio, which is widely used in investment decisions. This model is based on the first two moments of the distribution of returns. Similarly, Markowitz (1952), and Tobin (1958) provide risk models using mean – variance analysis. Samuelson (1970) criticized the mean-variance model as being confined only when the distribution of the variable of interest is Gaussian or when the utility function is quadratic, which "leads to well-known absurdities", namely, reducing risk aversion in wealth. However, the mean-variance model provides a good approximation when the risk is limited, i.e. near 0. If the variance of the distribution in question is sufficiently large as to have significant higher moments, then a two moment approximation will not converge to the true solution and the inclusion of the higher moments will be needed for a better result.

The inclusion of the third moment of a distribution in the utility function reflects the downside risk of a random variable. A positive skewness decreases downside risk, while a negative one increases it. Menezes el at. (1980), gives a general definition of increasing downside risk as the following: “one distribution has more downside risk than another if it can be obtained from the other by a sequence of probability transfers which unambiguously shift dispersion from right to the left without changing the mean and variance.” Cain and Peel (2004) studied the preference for gambles and stated that a risk-averse person has a preference for skewness; Moreover, a tradeoff exists among mean, variance and skewness. People are willing to trade a negative expected mean of returns for a positive skewness. According to Golec and Tamarkin (1998), the preference for skewness can be sufficiently large that even though people are faced with negative expected return and high variance on a gamble, they would still take the gamble as long as the skewness is sufficiently large. Peel (2012), on the other hand, provides examples where given different characteristics of lotteries and utility functions, risk-averse individuals do not necessarily prefer a more skewed distribution with equal mean or variance. However, investor’s preferences for skewness in returns are so common that there exist many mechanisms in the market to increase positive skewness of returns. Tsiang (1972) cites limited liability, prearranged stop-loss sales on stocks, and put and call options as examples of market mechanism to increase positive skewness of returns. Diminishing the magnitude of a financial loss and increasing the magnitude of the gain are ways to increase the skewness of returns.

Similarly, increasing the size of a loss and limiting gains decrease the skewness of the return distribution, and even make it negative, which is avoided by investors. This can occur if the income level of a firm is sufficiently low that it may be forced into bankruptcy and into liquidation of assets. The size of the loss in assets due to liquidations is related to the amount owed to creditors. If a firm's loss due to asset liquidation is sufficiently large, it may exhibit a jump discontinuity at a critical income level. Falling below that level would force the firm to liquidate assets in order to meet its obligations. Mason (1974) provides evidence of a utility function with a discontinuity in the form of a vertical jump, representing a large loss in utility due to income falling below a critical level. He makes analogies that the threshold is some situation that will lead us into an undesirable state of nature and thus cause a large disutility, like a divorce or being declared bankrupt. In this model, people get utility from both: income (or any variable of interest), and the state of nature. The different states are defined by being above or below the threshold level. Mason also states that an individual may show risk loving behavior in order to avoid falling into the bad state of nature; for instance, an investor may increase his share of an asset as its variance increases, even when its expected return is low, as long as the minimum return is not lower than the threshold level. This behavior relates to Roy's (1952) safety first criterion. Robinson and Lev (1986), referring to Mason's model, provide an example of a firm facing liquidation costs as the source of a disutility jump. They explain that the firm's decisions are to avoid falling below the threshold that causes the disutility jump. An investor may refrain from borrowing if the disutility caused by liquidating assets in the case of default is sufficiently large.

Chapter 6, the last paper of this thesis, addresses the current problem of widespread violence caused by narcos in Mexico. This is perhaps the first study on the effects of narco violence on agricultural production and rural life in Mexico. My interest on this subject began while preparing the farm survey for Mexico. I realized that the level of violence in the area of study increased dramatically in less than four years from virtually zero. In our survey, many people reported high anxiety level from fear of being a crime victim. Although most of the farmers we interviewed were small land holders, all of them were aware of the high violence level and most of them were concerned that they or a family member become victimized. Under the methodology developed by Slovic, I categorized the respondents in four groups using cluster analysis and compare their economic and demographic variables. I also analyzed the perception and reaction to violence using a psychology framework.

The level of violence in Mexico caused by the ongoing war on drugs has escalated dramatically in scale and scope affecting all members of Mexican society in many parts of the country. Based on official data from several government agencies, from December of 2006, when then newly elected president Felipe Calderon declared the war on drugs, to December of 2012, the newspaper Zeta estimates the number of homicides related to the drug war at over 50,000 (Proceso, May 28, 2012). Although most of these casualties are believed to be members of the drug cartels and government forces, many victims have been civilians unrelated to any side of the conflict. For instance, one of the most violent cases of attacks to innocent civilians is the arson of a casino in the city of Monterrey in August 2011, resulting in the dead of

53 people. This attack was perpetrated by a drug cartel when the casino refused to make extortion payments (Excelsior, August 26, 2011).

Among the risks derived from the drug war that affects civilians are kidnapping, extortion and carjacking. According to the Sistema Nacional de Seguridad Publica (2011) (National System of Public Safety), the official number of kidnaps in 2006 was 80% higher than the previous year. This number rose by 27% in 2007. The same agency reported the official number of extortions in 2007 to be 3,123. Kidnapping and extortion, along with homicide, are also called high-impact crimes for the lacerating effect that they have on society. Being exposed to these kinds of traumatic events, including disasters and acts of terrorism, create cognitive, emotional and social effects on the victims (Alexander D., Klein S., 2009). Some of these effects range from sleep disturbances, worry, and irritability to severe ones like psychic numbing, and recurring thoughts about the stressor (T. Markesteyn, 1992).

As dramatic as these events are, we are unaware of any studies that have investigated how narco violence impact the human psyche, the changes in risk perception, or how it affects life in general. More specific to this analysis is the effect of narco violence on agricultural productivity and rural life. By rural life we are interested not only in action but also perception, with the latter occurring at the emotional level.  I measure degrees of affect (a feeling of good and bad), defined by Slovic et al. (2007), of small farmers in the conflict zone. Specifically, I look in the emotions of farmers caused by the idea and actions of drug cartel members (narcos). Our area of study is located in a tri-state region in northeast Mexico, about 40 miles South from Tampico, where for the past years the level of drug related violence has been overwhelming. Local police have been supported by convoyed federal forces. In some cases, local police have been investigated on corruption and complicity with the drug cartels. They are dismantled completely if enough evidence is found. When this happens, military forces take over their duty of patrolling and enforcing security. The cities of Tampico and Veracruz are cases where the military are in charge of the local security (Proceso, April 19, 2012).

To investigate narco violence on economics and rural life we need to step back from traditional economic paradigms to gain an understanding of behavior itself. Thus, our study is more tied to psychology than economics, and in doing so we make some observations about behavior that are satisfying to both camps. In the psychological realm the problem posed is to know from which areas of psychology do we investigate. Two become clearly relevant, and we tie them together in a way which we have not previously seen done. The first is from the point of view of ecological psychology. Ecological psychology evolved principally from Gibson (1986) about how organisms relate to their environment. The domain of his research in ecological psychology has not at all been in the social domain, as is our interest in this paper, but the physical domain (P. Kugler, M.T. Turvey (1987); M.T. Turvey (2009); R. Shaw (2003)). The second strand views people's decision making as the interaction of two systems: the emotional and the analytical. This method of understanding decisions is called Dual Process. Under this paradigm, people's decisions are affected by their fear level, or the emotions invoked from an event; and also by their objective assessment of the probability of an event, a rational mechanism. This part of social psychology follows Slovic (2002, 2004); Slovic, Lichtenstein, and Fischhoff (1984); Finucane and

Holup (2006); Loewenstein, G., & O'Donoghue, T. (2005); Mukherjee K. (2010); Schulze W, & Wansink B. (2012). The two areas are different in several ways. Risk perceptions are for the most part non evolving, static events, where the ecological approach is dynamical. This does not mean that in terms of the researchers' toolkit the two strands of psychology should not be viewed as being mutually exclusive, but simply needs to be looked at through a different lens to see the connection. We argue that the Dual Process theory can complement the ecological psychology model, and to an extent we can say that the Dual Process is contained in the ecological psychology framework.

This paper within the thesis analyzes the relationship between psychometric measures of risk perception and socioeconomic variables of small farmers living in a drug conflict zone in Mexico. Farmers are classified into four groups, depending on their level of fear, and familiarity with living under risk and trust to authorities. For each of the four groups created I ran a multivariate regression on demographic, social and economic variables. In accordance to the literature, I find significant factors that determine group classification. Each of the groups is used as explanatory variables for determining stated changes in behavior due to violence. To our knowledge, this is the first study on small farmers' risk perception and production in conflict areas, specifically in the drug conflict areas in Mexico. Our results show that the current war on drugs in Mexico is not only affecting the urban population as it is widely perceived, but it is also affecting low income farmers. The increase in risk perception due to criminal activity also has an effect on their risk taking behavior and adoption of new production technology. Our results can help determine a strategy to lessen those risks perceptions and improve rural life.

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# CHAPTER 2

# DESCRIPTION OF SMALL SCALE MEXICAN FARMERS

## *Introduction*

This chapter provides a summary of the characteristics of the farmers under this study. Demographic, production and lifestyle information are captured through a survey conducted in 2011. The region of our study was chosen for three main reasons. First, many people there live off agriculture and complement their income with other productive activities. Most of these farmers are small landowners that have the choice of planting among three crops. Therefore, it provides an opportunity to analyze crop choice. Second, we have a working relationship with a local producers' association, Interagro de las Huastecas, S.A. de C.V. (Interagro). Through the help of Interagro, the survey was completed without any problem in a short time. Our local partner provided logistic support, sampling selection and enumerators. Last, when this research took place, the region was going through a period of insecurity caused by the presence of drug cartels (narcos) and its consequent criminal activities. Such criminal activities and the presence of narcos, army and navy were new phenomena for local people. This provides the opportunity to estimate how much this new type of risk is perceived and how much it affects rural life and agricultural production. Although Mexico has national statistics about rural communities, they are not design to capture risk perception and actions, and the frequency of them is too far apart. The results presented in this chapter provide a deeper understanding of small scale farmers and their activities at a time where safety conditions have changed.

The survey took place in September 2011 in a region known as the Huasteca in the state of San Luis Potosi, Mexico; specifically, in the municipalities of Ebano and Tamuin. The survey can be found in the appendix of this dissertation. The area of study is located approximately 80 Km west of Tampico, bordering the states of Tamaulipas and Veracruz. Given the location near a tri-state border, and a strategic route to Texas from southern Mexico, this region has become a turf war zone between two drug cartels starting few years back. However, the level of violence escalated in 2010, when the government killed a cartel's leader. At the time of this survey, violence level was so widespread that it affected the daily lives of people not involved in criminal activities. Narcos would find in kidnapping and extortion profitable activities. The presence of federal forces on highways and towns became a common sight, to the extent that in Tampico, the Mexican army and navy took over the duty of patrolling the city dismantling the local police, corrupted by the narcos.

The sampling and logistics were coordinated by our local partner. Interagro arranged the visits to the villages we surveyed. Those villages were selected to obtain a representative sample of farmers of that region. Our daily routine consisted in meeting the enumerators and Interagro's field engineer at the association's premises. The field engineer would arrange the trip to the population centers and inform us who to meet at each location in order to have a suitable meeting place and advertising of the survey to local farmers. The congregation place is generally a village main square or a public warehouse. Sometimes even the shade of some trees provided the congregation point to conduct the study. Most of time, farmers were invited to participate in our survey through loudspeakers located in the main public areas and others located strategically throughout the village. This is the most common way of conveying news in those rural communities, thus everyone is attentive to loudspeakers' messages. Many small scale farmers in Mexico belong to production cooperatives called ejidos. In some occasions we would talk to various ejidos' leaders to invite their members. Although this method reduces randomness in our sample, we tried to counter it by randomly selecting ejidos and limiting the number of member allowed to take the survey. Interagro provided the list of all ejidos within a village and their number of members, with this information we made the sampling as representative as possible. Even though some farmers are members of Interagro, our sampling decision was not affected by its membership. We analyzed any differences between members and non-members for academic completeness. Local college students were hired as enumerators. They responded to an ad placed in the local TV station. The enumerators were trained in two days: one day at the office and one day on the field. The data collected from the first day was not used in these results; we treated that day as a learning experience. A typical day in the field would start at 8am and finish at 5pm, for safety considerations we didn't stay in the villages past 5pm.

372 small scale farmers were interviewed between September 13$^{th}$ and 26$^{th}$ of 2011 in five different population centers in the region of Ebano and Tamuin, San Luis Potosi. The region of study is about 600 Km$^2$, being Ebano and Tamuin the largest towns with populations of 41,000 and 38,000 people respectively. Among the population centers that we study, the largest has about 6,000 people, while the smallest

about 3,000. Each survey participant was given $100 pesos to answer the survey, about a day's wage. This amount was divided into $80 pesos for completing the survey and $20 more if they agree to participate in a second survey a year later. The survey took about 45 minutes to complete. As a anecdotal account of farmer honesty, few participants did not want to accept the $20 pesos because they could not guarantee that they will be alive at the time of the second survey.

All farmers showed willingness to participate in the survey. Some farmers have taken part in past surveys before, mostly surveys from governmental agencies related to social programs. In fact, in two occasions we coincided in the same village with employees from the federal government conducting surveys to women belonging to a social program called Oportunidades.

### *Demographic Data*

Among all farmers interviewed, 86% are men and 14% female, ranging in age from 18 (legal age) to 87 years with an average of 53. 75% are married, 10% live under cohabitation, 5% are widowed and 8% are single. The divorce rate of the farmers is 2%, while the national average is 16%. 92% of farmers have children, being the average number of children 5 and the maximum 15. Among farmers who have children, 7.5% of them have 10 children or more. Although there are some families with more than 10 children, the average number of children, 5, is still very large compared to the national average (2.2). This average does not vary depending on the gender of the respondent (5.02 for women respondent and 5.08 for male respondent).

The average number of people in a household is 5 with a maximum of 17. The national average is lower at 3.9.

Mexico, starting in 2011, requires students to complete high school by law; despite this, the education level of the farmers in our study is very low. Among people older than 23 years old, 16.4% never went to school at all, 39.7 % attended elementary school but did not finish. Only 44 % completed elementary school, and 3.5% completed high school. From the sample, 3 people (0.8%) completed a technical degree, and 1 attended but did not finish technical school. However, government plans that in 2022, 100% of students in the country have access to high school. In Table 2.1, education is coded as follows: 0 = never attended school, 1 = some elementary school, 2 = finished elementary school, 3 = some middle school, 4 = finished middle school, 5 = some high school, 6 = finished high school, 7 = some college or technical school, 8 = finished college or technical school.

According to the national census (INEGI), 84% of the population in Mexico is catholic. The findings in our study are consistent with this rate, 80.91% of our sample responded to be Catholics. 20.67% attend only one religious celebration per month, and 86% attend on average once a week. Only 4% of the sample does not attend religious celebrations.

Land tenure in our area of study is mostly private. Most farmers belong to ejidos, a communal production group where each member own a given number of hectares but they would work together as a commune, under that scheme, nobody could sell their land. However, nowadays ejido members have legal possession of their land and can sell it and use it as collateral for credit. Ejidos were created when government allocated land to a group of landless farmers. Currently, no more land is expropriated to create ejidos. In our sample, 80% of farmers were given land as ejidos, 9.5% bought their land, and 6.8% inherited it. Almost all farmers, 97%, are sole owners of their land, just 2% rent land and 0.5% or farmers own land in a partnership. As a result that most of land was allocated by the government to ejido members, 66% own 10Ha or less, and 91% own 15Ha or less. Farm size doesn't change much.

The use of technologies of production such as fertilizers and pesticides are common among these farmers. 77% of farmers reported to use fertilizers and 97% used pesticides. However, only 28% of farmers have irrigation, mostly flood irrigation. These farmers are located near irrigation canals.

Agricultural credit is not very prevalent. 74% do not have agricultural credit, but those who borrow their average loan is 4,410 mxp, which is about 0.88% of the average total asset value. This refers to a loan taken by farmers to pay for production costs. Lines of credit do not seem to be included under agricultural credit. Lines of credit are included in total debt, not only on agricultural credit. Total debt stated includes lines of credit from buyers of agricultural suppliers, loans from friends or relatives, local lenders and associations. Among all farmers, 39% have any amount of debt. The average debt among all farmers is 8,250 pesos, ranging from no debt to 150,000 pesos. Among all farmers with debt, the average debt is 23,101 pesos. Most of this debt comes from lines of credit from the suppliers, about 56%, followed by loans from financial institutions, 25% of borrowers borrowed from financial institutions. About 7% of all borrowers borrowed from local lenders. These farmers pay the highest interest rate, 62% on average ranging from 16 to 144%.

Table 2.1. Sample statistics of surveyed farmers.

| Variable | mean | min | max |
|---|---|---|---|
| Female | 0.1370 | 0 | 1 |
| Age | 52.7957 | 18 | 87 |
| Education | 1.8428 | 0 | 8 |
| Children | 0.9193 | 0 | 1 |
| Number of Children | 4.9535 | 0 | 15 |
| Catholic | 0.8091 | 0 | 1 |
| Religious celebrations per month | 3.1580 | 0 | 30 |
| Farm size | 10.8482 | 0 | 40 |
| Farming years | 21.9752 | 1 | 68 |
| Irrigation | 0.2795 | 0 | 1 |
| Fertilizers | 0.7729 | 0 | 1 |
| Pesticides | 0.9704 | 0 | 1 |
| Farm Revenue | 44550.4 | 0 | 400000 |
| Total Revenue | 64825.97 | 6000 | 450000 |
| Procampo | 5653.737 | 0 | 27000 |
| Oportunidades | 3312.637 | 0 | 70800 |
| Total Income | 35107.34 | 4000 | 212000 |
| Debt | 0.3951 | 0 | 1 |
| Debt amount | 8250.57 | 0 | 150000 |
| Agricultural loan | 0.256338 | 0 | 1 |
| Amount Ag. loan | 4410.753 | 0 | 114000 |
| Total Asset Value | 502596 | 12000 | 2500000 |

Table 2.2.Debt source, amount owed and interest rate.

| | | Loan | | | Interest Rate | | |
|---|---|---|---|---|---|---|---|
| Source | Number | Average | Min | Max | Average | Min | Max |
| Friends | 11 | 8181 | 800 | 50000 | 15 | 0 | 60 |
| Relatives | 7 | 7357 | 500 | 18000 | 0 | 0 | 0 |
| Financial Institutions | 20 | 30550 | 2000 | 150000 | 35 | 12 | 97 |
| Local Lender | 9 | 32800 | 2000 | 100000 | 62 | 16 | 144 |
| Buyer | 13 | 17730 | 3000 | 40000 | 40 | 18 | 72 |
| Supplier | 70 | 20192 | 400 | 100000 | 36 | 12 | 132 |

Farmers were asked to rate several statements regarding borrowing habits from totally disagree to completely agree (1-5) using a Likert type scale. From these responses we find that 30% of farmers are afraid of borrowing formally from banks or buyers, while 50% stated that they are not afraid of borrowing formally. Most farmers have no outstanding debts with financial institutions or buyers (70%), while 12% claim to have outstanding debt with them. 73% claim that the interest rates charged by banks are much higher than the interest rate charged by friends and relatives. Almost all farmers (86%) state that they prefer to borrow from friends and relatives than formally at higher interest rates. 79% of farmers do not like to be indebted to financial institutions of buyers. Even if they could get a low interest rate from formal lenders, 55% would still not borrow from financial institutions; instead they would rather borrow from a friend or relative. When asked to rate the statement that if they would reduce input use for production in case they cannot borrow, almost 60% either agree or completely agree to it. About 60% agreed that if they cannot borrow, they would look for a job. About 50% do not agree that their children's education or healthcare is jeopardized by their inability to borrow; 34% believe education and healthcare are jeopardized by the lack of access to credit, while 18% are uncertain. Finally, when asked what they would do if they had all access to all the credit they needed 78% say that they would  stay in agriculture and increase production. 17% mention that they would start a non-agricultural business but stay in agriculture; only 2.4% would leave agriculture and start a non-agricultural business.

In order to measure the willingness to give up farming, farmers were asked about the minimum salary that they are willing to accept in order to work full time and leave their farm, either by selling or renting it. 87% of farmers are willing to take a job and leave their land, while 13% would not leave their land despite the monthly salary offered. Among those willing to take a job, they would accept an average monthly salary of 5,735 pesos. This salary is much higher than their farm revenues or total income; also, farm revenue and total income are higher for farmers willing to get a paid job than those unwilling. Farmers may be unwilling to take a paid job, even when it provides a higher (and steadier) income than farming, because of the utility they get from their land is higher than the utility obtained from a higher income. This may also be a reflection of the status quo bias; they are less willing to change their status quo or to give up something that they already own. Even for willing farmers, the high salary suggests that farmers have an intrinsic value of being a farmer. This can be the result of the lifestyle that farming offers, being their own boss, or simply because of the feeling of security of holding land. Unwilling farmers are more likely to have procampo subsidy than willing farmers. The safe cash transfer that this subsidy program provides creates more stickiness in the willingness to leave their land, even though their total income, including subsidies, is lower than what most farmers are willing to accept for a steady salary. These preferences should be taking into account when analyzing farmers' welfare

Table 2.3.Farmers willing to take a paid job and leave their farm.

| Willing to Leave Land | Percentage of Total | Age | Education | Min. Salary | Total Income (mxp) | Percentage with Procampo |
|---|---|---|---|---|---|---|
| 0 | 13.47% | 59 | 1.00 | - | 33,954 | 75.76% |
| 1 | 86.53% | 51 | 1.94 | 5,735 | 40,481 | 63.03% |

Farmers reluctant to give up their land for a steady job are usually older and have more children. These results are summarized in Table 2.3. It is worth to note that education is lower on those farmers unwilling to give up their land. From Table 2.4, I find that among people willing to give up their land for a steady job, 100% inherited their land, 93% bought their land, while 83% obtained their land from the government. It seems that it is more likely for someone to give up their land if they inherit or bought it rather than having obtained it through a government land reform program. However, most of people who received their land through the land reform are older and have the lowest level of education among all other forms of land origination.

Table 2.4.Land origin and willingness to take a paid job and leave their farm.

| Land Origin | Age | Education | Number of Children | Willing to Leave Land |
|---|---|---|---|---|
| Bought | 45 | 2.34 | 3.79 | 93% |
| Inherited | 40 | 3.16 | 3.38 | 100% |
| Given | 55 | 1.61 | 5.47 | 83% |
| Other | 33 | 3.50 | 3.22 | 100% |

Among all farmers, the average farming experience is 22 years, ranging from 1 to 68 years. The average farming experience for farmers who plan on growing corn as the main crop for next season is 22 years, for sorghum is 24 years and for soybeans is 20 years. The difference in mean is significant for soybean and sorghum farmers. Similarly, the average farmer age given planned crop is 53 for corn, 56 for sorghum and 50 for soybeans. They are statistically different from each other.

Farming experience and age is different depending on how farmers obtained their land. This may not be surprising, since expropriation of private land to distribute among landless is no longer possible. The last expropriation of private land took place about 1997 in this region. Farmers who bought their land have on average 12 years of experience and 45 years of age, those who inherited their land have 14 years of experience and are 40 years old, those who received their land from the government (80% of all farmers) have on average 24 years of farming experience and are 55 years old. It seems that farmers who inherited their land started farming at the youngest age among the other groups (26 years old against 33 and 31 for farmers who bought and received it from the government respectively.

Revenue from farming activities also depends on experience and age. After running a regression of farm revenue on farming years and age, I find that age affects farm revenue negatively, but experience affects it positively. However, the magnitude of the effect of age is greater than the effect of experience (-464 and 342 respectively). Age is statistically significant at p= 0.05, while experience is marginally significant at p= 0.19. As one ages, their physical and mental capacity also diminishes after reaching an optimal point. Considering this, I ran a second regression that includes age squared to capture the decreasing effect of age. The results have a positive value for farming years (p= 0.30), a positive and significant value for age (p= 0.12), and a negative and significant value for age squared (p= 0.05). This indicates that after a certain age, its effect on farm revenue start to decrease but the effect of experience remains positive.

Farming experience has a positive effect on the willingness to adopt new technology. Using a series of questions related to the willingness to use new technology and the importance of hedging strategies, I created an index of risk aversion. Regressing this index on farming experience and age I find that experience is positive and marginally significant at p= 0.28; while age is positive but not significant (p= 0.90)

***Income Structure***

Not surprising, most of farmer's total income comes from farming activities (60%), but many farmers complement their income through government programs, remittances and labor work. In this region all farmers have the option of planting corn, sorghum and soybeans depending on their soil quality, access to water, risk taking behavior and expected revenue per hectare.

In general, small farmers' earnings are very low. The national average minimum wage in Mexico for 2011 was 1,740 pesos per month (INEGI). Some farmers do not earn this much from farming activities. The average farm revenue from our sample is 44,550 pesos per year, or 3,712 per month, more than double the minimum wage. However, if we look at farmers according to their land size the results tell a different story. Farmers who have less than 10 hectares have average revenues of 29,747 pesos per year, those who have 10 hectares (mode) have sales of 40,825 / year, larger than 10 and up to 15 hectares the average revenue is 60,232, and for those farmers who have a farm larger than 15 hectares their average revenues is 61,019 pesos. It is important to remember that these figures are farm revenues and not net profit.

Table 2.5.Mean farm revenue and farm size.

| | Mean Farm Revenue | | |
|---|---|---|---|
| **Farm Size (Ha)** | **Observations** | **Year** | **Month** |
| < 10 | 98 | 29,747 | 2,478 |
| 10 | 148 | 40,825 | 3,402 |
| > 10, < =15 | 93 | 60,232 | 5,019 |
| > 15 | 33 | 61,019 | 5,084 |

Farm revenue depends on the type of crop planted and technology used. Farmers whose main crop in 2011 was soybeans showed the highest farm revenue and farm revenue per hectare in that year. The average revenue per hectare of soybeans was 5,888 pesos; followed by sorghum with 3,217 pesos / ha; and corn with 2,856 pesos / ha. In that year, 2011, most of people grew sorghum as their main crop (142 people) then soybeans (140 people) and finally corn (68 people). For the following year, 2012, many people switched from soybeans to corn and sorghum. Perhaps the net income from soybeans in 2011 was not large enough to justify the higher risk of this crop. Irrigation plays a very important role in farm revenue. Average revenue per hectare for corn without irrigation is 2,418 pesos, with irrigation this amount increases to 4,675 pesos. For sorghum it is 2,863 and 8,450; and for soybeans 4,536 and 6,989. When only fertilizers are used without access to irrigation the revenue per hectare is only slightly higher than the average revenue per hectare without irrigation. Fertilizers may not work if there is no water available to the crops. Their effectiveness is dependent on weather conditions. However, when both fertilizers and irrigation are used the revenue per hectare increases by a large degree. For instance, corn revenue per hectare when irrigation is available and fertilizers used increased to 6,386 pesos per hectare compared to 2,784 pesos when fertilizers are used but no irrigation. More dramatic is the case of sorghum, where the revenue per hectare with fertilizer and no irrigation is 2,842 pesos, but once irrigation is used it increases to 11,284 pesos, an increase of almost 4 times.

Table 2.6.Mean farm revenue per hectare by crop for 2011.

| | | Mean Revenue per Hectare | | | | |
|---|---|---|---|---|---|---|
| **Main Crop** | **Observations** | **All farmers** | **Without Irrigation** | **With Irrigation** | **Fertilizer + No Irrigation** | **Fertilizer + Irrigation** |
| Corn | 68 | 2,856 | 2,418 | 4,675 | 2,784 | 6,386 |
| Sorghum | 142 | 3,218 | 2,863 | 8,450 | 2,842 | 11,284 |
| Soybeans | 140 | 5,889 | 4,536 | 6,989 | 4,669 | 7,380 |

Farm insurance is not widely adopted by these farmers. Even though 37% of farmers know about it, only 9.7% of them buy crop insurance. Crop insurance is generally available through grain buyers and through producers' associations when farmers join the government's price support program. In the survey, farmers responded their willingness to pay for an insurance product that guarantees minimum revenue per hectare for each of the three crops. This product is not yet available in the Mexican market. Farmers responded on their willingness to pay in a scale from 1 to 4 for a range of prices that guarantees the average revenue per hectare for each crop. Insurance price ranged from 15% to 0.5% of payoff per hectare. For corn, 70% would not buy the revenue insurance at the 15% premium. Only when the premium decreased to 3% of the payoff, 65% of farmers showed a willingness to buy the insurance. Farmers showed a higher demand for sorghum revenue insurance. At the 15% price premium, 60% were interested in buying the product, and at 8% premium

91% of farmers were willing to buy it. Similar results were obtained for soybean revenue insurance, 82% of farmers willing to buy the insurance at the price of 8% of payoffs. Although farm insurance is not very prevalent in Mexico, a great percentage of farmers showed interest in revenue insurance, with over 65% of farmers having a strong willingness to pay for this product for all crops.

Non-farm income is also an important part of total income for some farmers. It comprises mainly government programs, remittances and labor work. One major government program aimed at agricultural production is called procampo. 251 farmers from our sample received procampo subsidy, 67% of total sample, under this production subsidy the government provides farmers a specific amount for hectare planted according to the crop planted. The average procampo received is 8,379 mxp per farmer, or about 25% of total farm income.  Farmers who did not receive procampo have similar farm income, without including subsidies, than those who received procampo. However, the total revenue for procampo recipients is slightly higher than non-recipients. Another major subsidy is called oportunidades. This program is a cash transfer aimed at women with children to help in their development and education. This program is conditional on children attending school. 52% of the sample households receive oportunidades. They have a significant smaller farm income than non-recipients of oportunidades, 54,140 and 35,559. This is consistent with the objective of the program to help the poorest families. Similarly, farmers who receive both programs (35% of sample) have the lowest average farm income at 33,471. These two government programs are the main cash transfers for poor rural families.

In our sample, 16.4% of farmers do not receive any of these two subsidies. 32% of households receive procampo only, 16% receive oportunidades only, and 35.4% receive both subsidies. Those who do not have any type of subsidy have the shortest time farming (17 years) compared to recipients of procampo (23 years) and recipients of both subsidies (26 years). Farm revenue varies according to subsidies received. Farmers who do not have any of the two subsidies average 4,423 pesos per hectare in farm revenues. Those who receive only procampo average 4,898 pesos. If they only receive oportunidades, their average revenue is 4,062 pesos. However, if they receive both subsidies, their average revenue per hectare is 3,374. We can see that production subsidy improves the average revenue if the household only receives this subsidy. Farmers who receive oportunidades only have the second lowest revenue per hectare. This may reflect the fact that oportunidades is aimed at the poorest families, and thus those with the lowest productivity. Interesting to note is that households that receive the production subsidy along with oportunidades, have the lowest average revenue per hectare among all groups. Perhaps the use of the production subsidy is not being used appropriately.

Table 2.7.Mean farm revenue per hectare by main crop in 2011.

| | | | Main Crop 2011 | | | |
|---|---|---|---|---|---|---|
| **Subsidy** | **Farm revenue / Ha** | **Age** | **Corn** | **Sorghum** | **Soybeans** | **Other** |
| None | 4,423 | 49 | 20% | 33% | 38% | 9% |
| Procampo | 4,898 | 54 | 12% | 38% | 49% | 1% |
| Oportunidades | 4,062 | 51 | 32% | 35% | 25% | 8% |
| Both | 3,374 | 54 | 17% | 42% | 33% | 8% |

Table 2.7 shows the main crops planted in 2011 for each category of subsidy received. Since procampo is given to the farmer conditioned on planting a given crop, we would expect that most of these farmers would plant any of the three main crops. In this region only these three crops are subject to the procampo subsidy. 1% of only procampo recipients did not plant one of the three main crops. However, for households that received both subsidies 8% of them did not grow any of the three crops as their main crop in 2011. 42% of them planted sorghum as their main crop, which is deemed as the safest crop among the three. In contrast, 38% farmers who do not receive any of the two main subsidies planted soybeans as their main crop. Procampo only recipients planted on average the most soybeans as their main crop (49%). Households that do not receive procampo, but receive only oportunidades grow on average the least soybeans. This may be because they do not have a production incentive and thus try to avoid the riskier crops.

The social program oportunidades provides cash transfer to low income families and those families that live in high poverty areas (Sedesol). Priority is given to women with children under 22 and to women of childbearing age, but all families whose income is under a threshold level can join the program. The purpose of this program is to increase human development through cash transfer conditional on children's school attendance and proper food intake. Beneficiaries of the program need to comply with regular medical checkups conducted at their locations. The amount that oportunidades beneficiaries receive depends mostly on the number of family members under 22 years old. There is a maximum amount a family can receive regardless of the number of children. In the sample, the group that only received oportunidades has the highest number of children among all other groups at 5.6. Beneficiaries of both programs, procampo and oportunidades, have on average 5.4 children while non-beneficiaries of any program average 4.2.

If we look at the respondents who are head of household, the results still hold for oportunidades recipients having the most number of children. Head of households who do not belong to any government program have the fewest average children (4.38) followed by procampo beneficiaries (4.69), beneficiaries of both programs (5.62), and finally oportunidades beneficiaries (5.87).

Oportunidades beneficiaries who are head of household also have the largest number of children under 6 and between 6 and 18 years old. They average 0.92 children under 6 years old, in contrast with non-beneficiaries at 0.74 children, a difference of 24%. Oportunidades beneficiaries have on average 1.95 children between the ages of 6 and 18, recipients of both programs average 1.96 children, while progresa beneficiaries average 1.31, and non-beneficiaries 1.45. Looking not at the number of children the respondent has, but at the total number of children living at the respondent’s home, the figures give a larger difference. The children who are not the respondent’s children might be their grandchildren. The average number of children between 6 and 18 who live in a house where the recipient is a beneficiary of oportunidades is 1.82. This number increases to 2.05 if the household belongs to both programs. In contrast, the average is 1.1 if the household does not belong to any program or belongs to procampo only. This is a difference of 65 and 86% from oportunidades and recipients of both programs. Given that the amount received increases with the number of children up to a point, a possible unintended consequence of this program could be an increase in the number of children among the poorest.

Table 2.8.Number of children per household and subsidy type.

| | | | Children Living at Home | |
|---|---|---|---|---|
| **Subsidy** | **Number of Children** | **Under 6** | **Between 6 and 18** | **Older than 18** |
| None | 4.38 | 0.74 | 1.45 | 1.13 |
| Procampo | 4.69 | 0.59 | 1.31 | 1.23 |
| Oportunidades | 5.87 | 0.92 | 1.95 | 1.17 |
| Both | 5.62 | 0.80 | 1.97 | 1.21 |

After controlling for other factors, the effect of belonging to oportunidades on the number of children is positive and significant (b = 1.32, p = 0.006). I ran a regression controlling for education, age, being catholic, farm size, farm income, total revenue, having procampo and having both procampo and oportunidades. Results are presented in table 2.6. Education is negatively related to number of children, although not at a significant level (p = 0.343). Age is positive and significant with a coefficient of 0.292 and a p-value of 0.00. Farm size, farm income, and total revenue are not significant in determining the number of children. The lowest p-value of them is 0.605. Being part of procampo has a negative but not significant effect (b = -0.359, p = 0.387), and belonging to both government programs, procampo and oportunidades, has a positive effect in the number of children (b = 0.802) while being statistically significant (p = 0.020). Catholic have fewer children than non-catholic, the coefficient of being catholic is -0.608 and the p-value 0.081. To check for robustness, I ran the same regression restricting the sample to people who have children and find that the significance  hold for all variables except female, which in the restricted sample regression has a coefficient of 0.641 and a p-value of 0.100.

Table 2.9.Regression of number of children on demographic variables and type of subsidy received.

| | **Coefficient** | **P-value** |
|---|---|---|
| Female | 0.416 | (0.294) |
| Education | -0.106 | (0.343) |
| Age | 0.292*** | (0.000) |
| Age^2 | -0.00186*** | (0.003) |
| Catholic | -0.609* | (0.081) |
| Farm Size | -0.00462 | (0.868) |
| Farm Income | -0.00000402 | (0.605) |
| Total Revenue | 0.00000322 | (0.658) |
| Procampo | -0.360 | (0.387) |
| Oportunidades | 1.317*** | (0.006) |
| Both Subsidies | 0.802** | (0.020) |
| Constant | -4.490** | (0.016) |
| Observations | 354 | |

*p*-values in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Although these results do not imply causality, they provide the relationship among variables on number of children. Important to notice is that income in any form, liquid assets or land, do not have predictive power on number of children. The most important factor that determines the number of children is age, regardless of income level. These results also show that people who belong to oportunidades have on average 1.3 more children than non-recipients, but if they also belong to procampo, then their average number of children over non recipients of government programs increases by 0.8 children.

### *Insecurity Perception and Narco Violence*

Since December 2006, Mexico has been facing widespread violence caused by the war on drugs initiated by the newly appointed government of Felipe Calderon. Since then, drug related violence, narco violence, has escalated in scale and scope in many parts of the country. Some estimates about the number of homicides related to the drug war are over 50,000 (Proceso, May 28, 2012) Our area of study is no exception. This area did not experience widespread narco violence until 2009, after one of the cartel's leaders was gunned down by the Navy the opposing cartel started a turf war that spread to this area. The nearby city of Tampico and its surrounding cities suffered much of the new types of crimes associated to drug cartels, kidnapping, extortion, homicide, and carjacking among others. Urban population, driven by the fear of being victimized, would change their daily life and in some cases would migrate to other, safer cities in Mexico and in the US. As a reference on the magnitude of the displaced population, Parametria, a consulting company, estimates the number of displaced people due to this war on drugs to be 1.6 million. (El Economista, Jan. $7^{th}$, 2012). However, drug related crime is not limited to urban population, but as I show, it affects rural population across all income levels.

Questions about insecurity were asked in the second part of the survey. The reason being that after spending time answering the first part of the survey and interacting with the interviewers, participants would be more likely to bond with the interviewers and thus be easier to open up to this sensitive topic. Participants were told at the beginning of the survey that they are not required to answer any question they don't feel comfortable with. They were reminded of this right at the beginning of the second part of the survey, of whenever the interviewer thought they hesitated in a question.

The first question we asked in the second part of the survey is whether they are aware of the current war on drugs. 85.22% of respondents are aware of the war on drugs, 7.26% are not aware, and 7.53% are not sure about it. Those aware of the drug war also consider themselves to be well informed on the community events, regardless of their number of friends and the frequency in which they meet. Having many friends and meeting them frequently does not imply that information about current events in the community will flow between them, or that the quality of information is assured. The results also show that older people tend to be less informed than younger ones.

Regarding insecurity level in their community, there is a clear trend that in the past two years it has increased. Participants responded to questions about how safe was living in their community in 2009, 2010 and 2011. They answered in a scale from 1 to 5, 1 being totally unsafe, 5 totally safe, 3 unsafe, with 2 and 4 measuring intermediate levels. The average response for 2009 is 3.8, with 23% feeling unsafe, and 0.54% felling totally unsafe. For 2010 the average response is 3.2, with the number of people feeling unsafe rising to 41.89%, out of which 6.22% feels totally unsafe. The average response for 2011 is 2.8. 71.89% feels 2011 to be unsafe and 11.62% feels totally unsafe.

Table 2.10.Safety level perception in the communities surveyed.

| Safety Level in their Community | Year and Frequency (Percentage of Total Responses) 2009 | 2010 | 2011 |
|---|---|---|---|
| 1 Totally Unsafe | 0.54 | 6.22 | 11.62 |
| 2 Very Unsafe | 1.35 | 11.62 | 25.41 |
| 3 Unsafe | 21.35 | 41.89 | 34.86 |
| 4 Safe | 68.11 | 36.49 | 24.05 |
| 5 Totally Safe | 8.65 | 3.78 | 4.05 |

Although in the area, especially in urban centers, by 2009 narco violence was beginning to affect many parts of society, it seems that it did not reach rural areas, or at least our area of study, until 2010. However, it is evident that people feel more insecure in 2011 than in the previous years. 53% of people respond to be very worried about the crime level in their community, however, this percentage increases to 66% when asked how worried they are regarding crime on roads. The level of anxiety about crime is the consequence of the perceived level of violence. 67% of people rate the level of violence in their communities in 2011 to be high and very high; while 75.67% perceive the violence level on roads to be high and very high.

Local police forces, in almost all cases, are unable to control narco violence because of the superior fire power of drug cartels and of their corrupting power over them. It is believed that federal forces, specially the Army and Navy, are harder, if not impossible, to corrupt by the drug cartels. For this reason, some cities are supported by federal forces in safety enforcing. Our sample supports this belief. 90% of the sample does not feel that the local police can respond and control narco violence; only 7.3% feel the same about the Mexican Army and Navy. That is, only 2.7% of the sample believes strongly that local police can control narco violence, while 52.97% strongly believe the Mexican Army and Navy can control narco violence. Table 2.11 summarizes these results.

Table 2.11.Confidence that police and army/navy can respond and control violent acts as percentage of respondents.

| | County/State Police | Mexican Army and Navy |
|---|---|---|
| Not Confident at All | 68.11 | 4.32 |
| Not Very Confident | 21.89 | 2.97 |
| Somewhat Confident | 7.30 | 39.73 |
| Very Confident | 2.16 | 31.08 |
| Completely Confident | 0.54 | 21.89 |

Although most of people believe that the crime level has increased in the past years, only 18.82% of people know someone who has been a victim of violent crime in the past 12 months. Specifically in this survey, I asked farmers whether they know a friend, relative or family member or if themselves have been a victim of a crime in the past 12 months. By crime I listed the following: carjack, personal robbery, kidnap, extortion, and homicide. Although in this region most of these crimes are new and originally related to the drug cartels, not all crimes committed are attributable to them. The prevalence of insecurity and the widespread of fear in the region have contributed to the upsurge of local bands of criminals unrelated to drug cartels. Given the fear of confronting drug cartels, victims of crimes, assuming that all aggressors are members of a drug cartel, do not seek help from the police, making it easier for local criminals to commit high impact crimes. For the purpose of this research, the person who committed the crime is irrelevant. These crimes were rare in this region before the drug cartels engaged into a turf war in 2009. That is, the widespread of these crimes originated from the presence of drug cartels in the region.

Crime incidence by type of crime and relation to the victim is given next. I present some statistics on crime for the entire sample, and then for those who know a victim of crime as explained in the previous paragraph. These results are summarized in Table 2.12. For each crime I separated the responses into three groups: crime committed to friends, crime committed to relatives and family, and crime committed to the respondent. Obviously, except for homicide all other crimes have the three groups. Starting with carjack, 4% of the entire sample knows a friend victim of it, 1.6% knows a relative or family member, and 1.07% state to have been a victim of it. For personal theft victims, 4.57% of the entire sample knows a friend victim of it, 1.6% knows a relative or family member, and 0.8% state to have been a victim of it. For extortion, 1.07% of the total sample knows a friend victim of it, 0.54% knows a relative or family member, and 0.27% of the sample claimed to be a victim of it. For victims of kidnapping, 1.61% of the total sample knows a friend who was kidnapped, 2.15% has a relative or family member who was kidnapped, and 0.27% of the sample claimed to have been kidnapped. In the case of homicide, 5.38% of the sample had a friend who was killed, and 0.54% of the sample had a relative of family member killed.

Table 2.12.Known victims by crime, as percentage of respondents.

| Crime | Known Victim | Entire Sample | If Know Victim of Crime |
|---|---|---|---|
| Carjack | Friends | 4.03% | 21.43% |
| | Relatives/Family | 1.61% | 8.57% |
| | Self | 1.07% | 5.71% |
| Personal Theft | Friends | 4.57% | 24.29% |
| | Relatives/Family | 1.61% | 8.57% |
| | Self | 0.80% | 4.29% |
| Extortion | Friends | 1.07% | 5.71% |
| | Relatives/Family | 0.54% | 2.86% |
| | Self | 0.27% | 1.43% |
| Kidnap | Friends | 1.61% | 8.57% |
| | Relatives/Family | 2.15% | 11.43% |
| | Self | 0.27% | 1.43% |
| Homicide | Friends | 5.38% | 28.57% |
| | Relatives/Family | 0.54% | 2.86% |

The last column of Table 2.12 shows the percentage of people who know a friend, relative or family member, or if himself has been a victim of the aforementioned crimes from the sample of people who know a victim of crime.

For a given crime most people know a friend victim of it, followed by relatives or family, and then by oneself. This is true partly because people tend to have more friends than relatives. However, in our sample more people know a relative and family member to be a victim of kidnapping than a friend. Surprisingly, the most common known victim of crime is friends who were killed at 5.38% of the sample. Victims of carjack and personal theft are known more than victims of extortion and kidnapping. This is no surprising since personal theft and carjack are easier and quicker to perform than extorting and kidnapping someone. It is worth noticing that even though the sample is made up of low income farmers, some of them have experienced or known a victim of crimes like kidnapping and extortion where affluent people are more likely to be the target. This results show that even in poor rural communities, people are not exempt of high impact crimes.

The survey asked questions about the risk that they, and their own families, become a victim of the previously stated crimes, and also about the fear of that happening. Specifically, these questions asked about the likelihood and fear of being victimized in the next 12 months. As usual, the list of crimes was given and the participants responded on a 1 to 5 scale, ranging from not likely at all, to totally likely, in the case of likelihood of victimization; and from no fear at all to fear too much, in the case of fear of victimization. In the questions about victimization fear, I included two parts: one to measure how afraid the respondent is that he becomes a victim of crime; the other part measures how afraid is the respondent that a member of his family becomes a victim of those crimes.

People are more afraid to have a family member victimized rather than themselves for all five crimes mentioned. The difference in fear level varies according to crime. In general, the more severe a crime is, the larger the fear difference becomes. For instance, fear of being robbed has the smallest difference, followed by fear of being physically assaulted. The crimes with the highest difference in fear are the high impact crimes in the following order: homicide, kidnapping and extortion. However, the absolute fear level for each crime does not necessarily indicate its degree of aversion. These responses incorporate the likelihood of being victimized for a given crime. Thus, even if a crime is deemed to be serious, the fear level may not necessarily be high when the likelihood of it is very low. Table 2.13 summarizes the results on fear level and its differences for all crimes. Values are means of each category.  The difference is computed as the mean difference and not as the difference in means.

Table 2.13.Fear level of victimization for each type of crime.

| Crime | Fear of Becoming a Victim Yourself | Fear a Family Member Becomes a Victim | Difference |
|---|---|---|---|
| Personal Theft | 2.59 | 2.68 | 0.086 |
| Carjack | 1.88 | 2.00 | 0.116 |
| Physical Assault | 2.55 | 2.67 | 0.116 |
| Extortion | 2.52 | 2.65 | 0.125 |
| Kidnapping | 2.40 | 2.53 | 0.127 |
| Homicide | 2.40 | 2.56 | 0.159 |

Risk of being victimized compared to other families depends among other factors in how one's family is perceived by others. Questions were asked about how much they think their families are perceived by other families in the community among different aspects. These aspects are: asset rich, vulnerable, socially active, cash rich, powerful. No further explanations on those aspects were given to the participants. These indirect questions about themselves provide answers on how they perceive their own family without being direct. Therefore, whatever they respond on other's perception on their own family should correspond with their actual situation.

The likelihood of being victimized within the next 12 months is low for all crimes. Even though for all crimes the likelihood ranged from 1 to 5, the highest average among the crimes is 2.56 and the lowest 1.87.  Probability of carjacked has the lowest average, followed by homicide, kidnapping, physical assault, extortion, and personal theft. In the survey, a value of 2 is very low probability, and 3 is probable. For most crimes, the likelihood of victimization increases with age but at a decreasing rate. Except for kidnapping, all other crimes have a positive and significant coefficient for age and negative and significant age squared. Except for carjack, being considered land rich has a negative and significant value in the likelihood of victimization. This could be derived from a sense of security from owning land. Being considered vulnerable has a positive and significant effect. An interesting finding is that for most crimes, being considered socially active has a negative and significant effect. Again, a feeling of security may be caused by having many friends and being able to rely on them. Gender has no effect on the likelihood of crime, but education has a positive effect.

Living in an unsafe region has consequences in the way people live. It is natural that when people feel at risk they change their behavior to adapt to the new environment. In this research, I find that many people have altered their daily activities or have planned of doing something to cope with the violence. In my sample, 18% of the people know somebody who has moved out of the community for fear of being victimized. Even though 84% of the respondents have never considered moving out of town because of the violence, 7.8% have considered it a few times, 5.9% some times, and 2% many and all the time. That is, 16% have considered moving out of town at least some time. 8% of the farmers surveyed have changed production decisions because of the violence, and 14% have changed their daily activities. If the current violence level continues, 35% would change production decisions in their farms. These results show that the effect of narco violence in rural life is non-trivial, and that urban population is not the only one suffering the consequences of the drug war. Narco violence affects not only daily rural life but also production decisions.

### *Conclusion*

This chapter presents the results of a survey on Mexican grain farmers conducted in 2011. The importance of this survey is that it provides a summary on the conditions of these farmers as well as other information related to the current violence level caused by the war on drugs. This survey, to my knowledge, is the first one to be done in a real time conflict zone in Mexico. It provides information on demographics, production, risk taking behavior, and risk perception on violence that was previously not known.

Besides summarizing information on farmers, this survey provides information on risk attitudes and demand for risk contingent credit products. Risk attitudes are measured as the willingness to adopt new technology. Their analysis provides insights into how to better address technology adoption programs. Risk contingent credit is a collateral-free credit. It is especially suited for low income farmers, and those that do not borrow formally for fear of losing collateral, also referred as risk rationed farmers. Currently this financial product is unavailable to them; however, most farmers stated a desire to have this type of credit.

Violence and how it affects farming decision and rural life is also investigated. The current war on drugs has spread into many parts of the country. Rural areas are no exception. This study provides evidence that narco violence affects production decision, daily activities and rural migration. How violence is perceived by farmers is also analyzed. These results shed light into the determinants of fear, which ultimately causes changes in behavior.

The results of this survey shows only one part of the rural life in Mexico. Some aspects of these farmers, like production as well as fear level, are specific to the region. This survey can provide a reference for future research, much needed in Mexico.  For instance, a follow up survey to determine changes in risk and violence perception could be done. There are a lot of research opportunities in rural Mexico at the moment; unfortunately narco violence makes it harder to conduct field research.

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CHAPTER 3

# CROSS MARKET PRICE SUPPORT AND AGRICULTURAL DEVELOPMENT

***Abstract***

The need for creating mechanisms that reduce price risk for farmers in developing countries has been cited as a priority for economic development by the World Bank (2005). Accordingly, this paper develops a market driven mechanism for commodity price insurance in those target countries. Our model incorporates futures, exchange rate and local basis risk under the Black-Scholes framework to develop quanto (Quantity Adjusting Option). When the domestic price of a commodity in a developing country is strongly correlated to the price in a futures market, price support premiums can be estimated. We calculated the price insurance premium at various local markets in Mexico for corn and sorghum. Our results are consistent with those for the US, showing that relative price premiums are similar.

*Introduction*

Commodity price insurance products are easily available to farmers in developed countries. For instance, institutional futures markets provide agricultural producers and buyers with financial derivatives to hedge against price uncertainty. Corn farmers in the US have access to futures and options contracts through the Chicago Mercantile Exchange (CME). The exchange provides price disclosure and standardized contracts, which facilitates commercial operations. However, in most developing countries, with no organized futures exchange, producers and buyers do not have direct access to these types of products. In its World Development Report of 2005, The World Bank acknowledged the importance of reducing price risk as a priority for economic development. Among the policy options described in the report to manage risk, the main ones are the piloting and adoption of market-based risk management instruments; and the creation of countercyclical safety nets for poor farmers (World Bank, 2005). However, in most instances the market instruments required is a derivative of a security (e.g. futures contract) denominated in a currency that differs from the target client. For instance, the Mexican government through a marketing program buys options at a futures market in the US in order to hedge farmers and buyers positions. Using US wheat futures and options contracts are analyzed as a hedging strategy in Pakistan (Faruqee, Coleman and Scott, 1977). Thus, not only is basis and price risk critical elements but also important is foreign exchange rate. The burden of mispricing publicly provided risk management ultimately rests with either the farmers whom are to be the beneficiaries (if the price is too high) or tax payers (if the price is too low), and without computational guidance this can become costly. In order to fulfill programs such as discussed in the World Bank report, techniques are required to properly price risk on a probabilistic basis. Policy makers must take into account not only the price risk of the foreign security, but swings in exchange rates and local basis. This requires a unique approach and the purpose of this paper is to describe and illustrate the pricing mechanism on an actuarial basis using options theory. This paper address the two policy priorities outlined by the World Bank by illustrating how futures price, basis and foreign exchange affect local cash prices and its derivatives. These two policy priorities can be met by means of the market-based quanto (Quantity Adjusting Option) pricing mechanism described in this paper.

The subject matter of this paper deals with the price protection of grains in Mexico. Problems faced by Mexican farmers are typical of the problems faced by producers of the World Bank target countries. In general, they lack the financial infrastructure needed to insure their crops, like institutional futures markets or over-the-counter (OTC) markets. How we deal with the Mexican case lays out some fundamental strategies that can be scaled up or down to address similar issues in other developing agricultural economies where price risk is largely determined offshore, that is, from futures markets that affect local prices, and the foreign exchange rate.

In Mexico, the most common way for grain producers to hedge price risk is by participating into a government sponsored option contract program called *Programa de Administración de Riesgos a través de Intermediarios Financieros* (PARMIF). This program began in July 31st, 2012, substituting the program *Agricultuta por Contrato*. Under PARMIF, registered producers sign forward contracts with buyers and then register those contracts with financial institutions certified by the government, which guarantees each party the contract price through put or call options. Producers select the degree of coverage at the certified financial institutions. Option premiums are subsidized by the government for both parties but at different rates, up to 85% for producers and 50% for buyers. Adverse basis are also covered by the government. Local prices for basis estimation are calculated by adding to the closest futures price contract quoted at the CME transportation, storage and financial costs to commodities at relevant port of entry. Depending on the distance to these ports, the basis for each local market is calculated. The price at each port of entry is also calculated on the futures price at the CME plus local basis, which are published and thus publicly available in the US.

Although the benefits of price guaranteed programs, like PARMIF are evident, there are also problems in its reach. The program subsidizes any contract cost to both parties and provides a guarantee against counterparty default. Farmers are not subject to basis risk under this scheme; any price movement against the farmer is covered by the government. Nevertheless, the requirements for producers to be part of the program can be overwhelming and consequently some producers may not meet the criteria. Because this program is not market driven but politically motivated, the success of it depends on its assigned budget. There are times when farmers are left out due to lack of funding (Echánove, 2009). Excluded farmers may engage into forward contracts directly with large grain buyers and processors, but without government sponsorship these contracts are subject to default risk. Also, not all grain contracts in México are supported through this program.

### *Background*

Quanto, or cross currency, options are used when the underlying asset of an option is quoted in a different currency than its payments. For instance, an option on the Nikkei index in US dollars is a quanto option since the underlying asset, the Nikkei Index, is quoted in Japanese yen, but its payoffs are quoted in US dollars. Multinational companies with cash flows in many currencies benefit from this type of options, which are mostly sold in OTC markets. Despite its relevance in globalized economies, the amount of research done on quanto has not been large. For instance, an unrestricted search in Google Scholar in October 2012 of the words “cross currency options” returns 156 articles. Most of the analysis of quanto options has been made on foreign exchange indexes. Earlier papers on cross currency options include Biger and Hull (1983), Giddy (1983), Grabbe (1983) and Rumsey (1991). Wei (1996) develops a closed form pricing formula for cross currency bond option with deterministic volatilities. Duan and Wei (1999) develop it under stochastic volatility of exchange rate and foreign asset price. Branger and Muck (2012) study the price of quanto options when covariances are random. Quanto options research and its application in agricultural commodities are very limited. For instance, in Canada some OTC products offered to farmers were priced in Canadian dollars with the underlying priced in USD; however, those options did not consider basis risk (Braga, 1996). Accounting for basis risk, Turvey and Yin (2002) analyze the application of quanto options to agricultural commodities in Canada at several locations.

Producers in developing countries generally lack access to financial markets that provide insurance against covariate price risk. Their financial systems are usually not sophisticated enough to provide these type of products. Government programs, in most cases, become the main provider of price insurance for farmers. The motivation of these programs is to create social stability in the event of sharp decline in prices, which causes a welfare loss to producers. In Mexico for instance, under the federal government program PARMIF, farmers are guaranteed a minimum price for their harvest through option contracts. Farmers and buyers are not required to hold margin accounts, but are protected against basis and default risk by the government. Buyers and producers reach an agreement on the volume and price of the product with delivery places and dates stated in the contract. These prices are based on the price of grains at an entry port plus transportation, storage costs, expected demand and profit margins. The federal government becomes a liaison between the two parties and buys at the CME their respective option positions. The government subsidizes partially the option premium of both parties. Since margin accounts are not required, the contracts are guaranteed by the government in case of default; and in case of adverse market prices at maturity, the government compensates each party. Farmers are fully protected against unfavorable price movements, making it a risk free contract; grain processors and buyers are also covered but not completely. In order to participate, each producer must meet certain requirements to be eligible, including minimum land and production quotas. Farmers have to either meet the contract quota by themselves or belong to a producers' association and share the production quota. Currently only corn, sorghum and wheat are eligible for this program. Moreover, the existence of those programs depends on an assigned budget and is subject to political debate

***Model***

The purpose of this paper is to develop a market driven mechanism for commodity price insurance in Mexico. Turvey and Yin (2002) develop a quanto model that includes CME traded futures, exchange rate and basis risk for an over-the-counter Canadian hog options program based on the Black-Scholes (1973) framework and equilibrium conditions; we use this framework for guidance. Given that local prices in Mexico for yellow corn, white corn and sorghum are highly correlated to local prices of yellow corn in the US, and hence to its futures price at the commodities exchange in Chicago, the option pricing method for local commodities in Mexico is one where two currencies are involved. One of these is in which the underlying asset is quoted, in this case is yellow corn at the commodities exchange quoted in usd, and the other currency is in which payments are made, i.e. Mexican peso (mxp). This class of derivatives, involving more than one currency, a quanto In the case of commodity prices in Mexico, local prices are determined by the price of the commodity in a US market plus transportation costs to a Mexican port, the conversion to Mexican peso plus an adjustment of local basis for each market. Local prices are defined by

$$P_{t,i} = F_t E_t + B_{t,i} \qquad [1]$$

where $P_{t,i}$ is the local price of a given commodity at time $t$ and for location $i$, $F_t$ is the nearby futures settlement price for yellow corn quoted in usd at the CME at time $t$, $E_t$ is the exchange rate mxp/usd at time $t$, $B_{t,i}$ is the local basis in mxp for market $i$. Each component of the local price is assumed to follow a geometric Brownian motion with a drift: $dF = F[\mu_F dt + \sigma_F dw]$, $dE = E[\mu_E dt + \sigma_E dw]$, $dB = B[\mu_B dt + \sigma_B dw]$ where μ is the annual growth rate, $\sigma$ the standard deviation of the growth rate, and $dw$ follows a Weiner process $et^{0.5}$, where $e \sim N(0,1)$. The local price, by looking at its components, can be assumed to follow a Brownian motion of the same form $dP = P[\mu_P dt + \sigma_P dw]$. We obtain the local price growth rate, $\mu_P$, and variance, $\sigma_P{}^2$, after applying Ito's lemma to the local price equation [1].

$$\mu_P = \left(\tfrac{FE}{P}\right)\left( \mu_F + \mu_E + \rho_{F,E}\, \sigma_F\, \sigma_E\right) + \left(\tfrac{B}{P}\right) \mu_B \qquad [2]$$

$$\sigma_P{}^2 = \left(\tfrac{FE}{P}\right)^2\left( \sigma_F{}^2 + \sigma_E{}^2 + \rho_{F,E}\, \sigma_F\, \sigma_E\right) + \left(\tfrac{B}{P}\right)^2 \sigma_B{}^2 + \left(\tfrac{FEB}{P^2}\right)\left(\rho_{F,B}\, \sigma_F\, \sigma_B + \rho_{E,B}\, \sigma_E\, \sigma_B\right) \qquad [3]$$

Under no arbitrage opportunities, there exists a risk neutral rate used to price options. This rate is used to discount future cash flows of the derivative. The currencies involved and the commodities are tradable that can create a hedge portfolio. No arbitrage opportunities are assumed by the law of one price. We test the no-arbitrage condition by testing whether price processes follow a stationary geometric Brownian motion (GBM) in another section of this paper.

The risk free growth rate for futures and exchange rate is defined by usual arbitrage conditions. The arbitrage free price for the future price of the commodity becomes the risk free rate minus carrying costs, δ, of the commodity at base currency: $\mu_F = (r_f - \delta)$. Where $r_f$ is the risk free rate in the US. For the exchange rate, its arbitrage free growth rate is a function of the difference in the risk free rates of the two countries, $\mu_E = (r - r_f)$. $r$ is the Mexican risk free rate measured as the return on 28-day government bonds. From the above, we obtain the basis risk free growth rate as, $B_T = B_0^{e^{\mu_B - \lambda\sigma}}$.

The risk neutral growth rate is defined by $r^* = \mu - \lambda\sigma$. We assume that the risk premium for each local market is estimated using the Capital Asset Pricing Model: $\lambda\sigma = \beta_i\ [R_m - r]$ with $\lambda$ being the market price or risk of a state variable and $\sigma$ its volatility[2]. $\beta_i$ , beta, is the covariance between the Mexican stock market index, IPC, and basis at location $i$; $R_m$ is the annualized return of the Mexican market. Under risk neutrality the risk premium of all assets involved in the option is zero. CAPM is convenient since it does not depend on risk preferences, and doesn't require the state variable to be traded (Roll, 1977). From [2] and [3] and using the corresponding risk neutral rates, we obtain the following local cash price change rate to value the quanto at each location $i$:

$$\frac{dP}{P_i} = \Big(\omega\big(r - \delta + \rho_{F,E}\ \sigma_F\ \sigma_E\big) + (1-\omega)\big(\mu_{B,i} - \beta_i\ [R_m - r]\big)\Big)dt\ +\ \omega(\sigma_F dW_F + \sigma_E dW_E) + (1-\omega)\sigma_{B,i} dW_B \qquad [4]$$

[2] Generally speaking the market price of risk is an economic metric required to compensate investors when the underlying cannot be hedged with market instruments to create a risk-free portfolio. It captures market risk aversion.

Where ω is the percentage of the local price that depends on the future price quoted at base currency, EF/P; and 1- ω is the percentage of local price that depends on the basis, B/P.

Since this analysis considers protection for producers, we are only estimating quanto put prices. However, we can easily estimate the quanto call prices, which are used by buyers to hedge against price increases. The quanto put price is then calculated using the Black-Scholes formula.

$$f_p = Ke^{(-rT)}N(-d2) - P_0\, e^{[(\theta - r)T]}\, N(-d1), \qquad [5]$$

with the boundary condition $\max[K - (P_T E_T + B_T),0]$, where $K$ is the strike price, $T$ is time to maturity, and $P_0$ is the cash price at time 0, i.e. at time of valuation. $d1$ and $d2$ are given by:

$$d1 = \frac{[ln\,(\frac{P_0}{K}) + (\theta + 0.5\,\sigma_P{}^2\ )\,t]}{\sigma_P\sqrt{t}}\text{, and } d2 = d1 - \sigma_p\sqrt{t}$$

From the differential equation [4] we estimated

$$\theta = (\omega r - \delta + \rho_{F,E}\ \sigma_F\ \sigma_E\ ) + (1 - \omega)\ (\mu_B - \beta_i\ [R_m - r])$$

Once the quanto put price is estimated by the model, we can calculate the quanto call price by using the put-call parity. However, for the purpose if this paper, we only estimated put prices.

*Comparative Statics*

The quanto option as presented above has many moving parts and how these change or relate to each other is important from the pricing and policy standpoint. The effect of the option price caused by changes in variance of the three sources of risk, i.e. basis, futures price and foreign exchange rate, are analyzed in this section.

*Effect of $\sigma_p$ on $d1, d2$ and $f_p$*

The derivative of d1 with respect to $\sigma_p$ is $\frac{dd1}{d\sigma_P} = \sqrt{T} - \left[\frac{\ln\left(\frac{P}{K}\right)+T\left(\frac{\sigma_P{}^2}{2}+\theta\right)}{\sigma_P{}^2\sqrt{T}}\right]$, which is positive if $\sigma_p{}^2 > \frac{2\ln\left(\frac{P}{K}\right)}{T} + 2\theta$, and negative otherwise. If the option's strike price is larger than the local price, $K \geq P$, the value of $\frac{2\ln\left(\frac{P}{K}\right)}{T} \leq 0$; if this happens, when $\sigma_p{}^2 > 2\theta$, the derivative $\frac{dd1}{d\sigma_P} > 0$. Otherwise, if $K < P$, then the value of $\sigma_p{}^2$ has to be much larger than $2\theta$ for the derivative to be positive. Our estimated values for $\theta$ are about 0.07, while $\sigma_p{}^2$ is about 0.05; thus, in our model the effect of a change in the local price volatility to the value of $d1$ is negative, $\frac{dd1}{d\sigma_P} < 0$ for $\leq P$ . Only when the value of $K > 1.05\ P$, the derivative becomes positive.

The derivative of $d2$ is quite similar: $\frac{dd2}{d\sigma_P} = -\left[\frac{\ln\left(\frac{P}{K}\right)+T\left(\frac{\sigma_P{}^2}{2}+\theta\right)}{\sigma_P{}^2\sqrt{T}}\right]$. This value is positive when $-\frac{2\ln\left(\frac{P}{K}\right)}{T} - 2\theta > \sigma_p{}^2$. In other words, if the strike price is much higher than the cash price at low values of $\sigma_p{}^2$, the derivative eventually turns positive. It is negative if the opposite holds. Given the value of our estimated $\sigma_P{}^2$ and $\theta$, we have $\frac{dd2}{d\sigma_P} < 0$ when $T = 1$ and $P$ is about 90% or larger than $K$. The effect changes once $P$ is less than 90% of $K$.

Next we analyze the effect of local price variance on the quanto price. This is the vega of the quanto. For the complete derivation refer to the appendix. This derivative becomes $\frac{df_p}{d\sigma_P} = Ke^{(-rT)} \frac{\partial N(-d2)}{\partial d2} \frac{\partial d2}{\partial \sigma_P} - P_0\, e^{(\theta - r)T} \frac{\partial N(-d1)}{\partial d1} \frac{\partial d1}{\partial \sigma_P}$. Where the terms $\frac{\partial N(-d2)}{\partial d2}$ and $\frac{\partial N(-d1)}{\partial d1} < 0$. The function $N(\,)$ is the standard normal cdf, and so, it is increasing in its argument. $\frac{\partial N(d_i)}{\partial d_j} > 0 \;\; i,j \in (1,2)$, but because of the negative sign in the put option formula, its derivatives are negative. The signs of $\frac{\partial d2}{\partial \sigma_P}$ and $\frac{\partial d1}{\partial \sigma_P}$ can be positive or negative according to the conditions previously mentioned. The result of the derivative $\frac{df_p}{d\sigma_P}$, which is the option's vega, can be simplified as $P_0\sqrt{T}e^{(\theta - r)T} \frac{\partial N(d1)}{\partial d1} > 0$, where $\frac{\partial N(d1)}{\partial d1} = \frac{1}{\sqrt{2\pi}}\, e^{\left(-\frac{d_1{}^2}{2}\right)} > 0$. The effect on both put and call options is positive and consistent with the literature, $\frac{df_{p,c}}{d\sigma_P} > 0$ (Merton, 1973).

*Effect of $\sigma_F, \sigma_E, \sigma_B$ on $\sigma_P$*

Since we are interested in knowing the effect of the changes in our three sources of risk, we proceed to estimate the quanto price derivative with respect to futures price, exchange rate and basis. The variances of all risk factors affect the quanto through changes in $\sigma_P$. Only $\sigma_F$ and $\sigma_E$ affect $\theta$ as well. Since basis risk only has an effect on the put price through $\sigma_P$, the derivative $\frac{df_p}{d\sigma_B}$ is simplified to:

$$P_0\sqrt{T}e^{(\theta-r)T}\,\frac{\partial N(d1)}{\partial d1}\frac{\partial \sigma_P}{\partial \sigma_B} \gtreqless 0$$

The derivative $\frac{\partial \sigma_P}{\partial \sigma_B}$ determines the sign of $\frac{df_p}{d\sigma_B}$, and its result is:

$$\frac{\partial \sigma_P}{\partial \sigma_B} = \frac{[\frac{1}{p^2}(2B^2\sigma_B + BFE(\rho_{E,B}\,\sigma_E + \rho_{F,B}\,\sigma_F)]}{2[\frac{1}{p^2}(B^2\sigma_B{}^2 + E^2F^2(\sigma_E{}^2 + \sigma_F{}^2 + \rho_{F,E}\;\sigma_F\sigma_E) + BFE(\rho_{E,B}\,\sigma_E\,\sigma_B + \rho_{F,B}\,\sigma_F\,\sigma_B)]^{1/2}} \qquad [6]$$

For the denominator to be positive, the next condition needs to hold:

$$\frac{B}{FE}\sigma_B{}^2 + \frac{FE}{B}(\sigma_F{}^2 + \sigma_E{}^2) > -\frac{EF}{B}\,\rho_{F,E}\;\sigma_F\;\sigma_E - \rho_{E,B}\;\sigma_E\;\sigma_B - \rho_{F,B}\;\sigma_F\;\sigma_B \qquad [7]$$

This condition holds for our data, where all correlation values are negative for sorghum and yellow corn, and only the correlation between basis and exchange rate is positive for white corn at each location. As an illustration, for Guadalajara the left and right hand side of equation [7] for sorghum, white corn, and yellow corn are respectively:0.344, 0.027; 0.383, 0.015; and 0.283, 0.022. This is by no means a general rule; it is an empirical problem. The results and the effects of the risk variables are data driven and may be different depending on the characteristics and conditions of the area in study. In our data the denominator of [6] is always positive; thus, its numerator defines the sign of the derivative. Its effect can be either positive or negative depending on the correlations between futures and basis, and exchange rate and basis. If both correlations are zero or positive, then the effect of basis risk on local price risk is positive. If both correlations are negative, as it is the case in our data, the effect of a change in basis risk depends on the sum of the products of the correlation of futures and basis times the volatility of futures and correlation of exchange rate and basis times the volatility of exchange rate. If this value is larger than twice the basis volatility times the ratio of basis and futures price in local currency, then the effect on price volatility is positive, otherwise it's negative. These conditions are:

$\frac{d\sigma_P}{d\sigma_B} > 0$, when $\rho_{F,B}\ \sigma_F + \rho_{E,B}\ \sigma_E > \frac{2B\sigma_B}{FE}$; and $\frac{d\sigma_P}{d\sigma_B} < 0$, when $\rho_{F,B}\ \sigma_F + \rho_{E,B}\ \sigma_E < \frac{2B\sigma_B}{FE}$

Our data supports the first condition, change in basis risk increases local price volatility. The effect on put price is also positive, but opposite for call prices. For instance, the value of the numerator of [6] for Guadalajara for sorghum, white corn and yellow corn are: 0.032, 0.091, and 0.021. In the scenario that the two correlations have opposite signs, the effect of a change in basis risk corresponds to the sign of $\frac{2B\sigma_B}{FE} \gtreqless -\rho_{F,B}\ \sigma_F - \rho_{E,B}\ \sigma_E$.

The derivative of the put price with respect to the other two variances, futures price and exchange rate, are analyzed next. Since their changes alter the risk neutral rate as well, their effect on the option prices depends not only on $\frac{\partial\sigma_P}{\partial\sigma_i}$ but also on $\frac{\partial\theta}{\partial\sigma_i}$, where $i$ stands for futures price and exchange rate. The derivative $\frac{df_p}{d\sigma_i}$ is simplified in the following formula. The complete derivation can be found in the appendix.

$$\frac{df_p}{d\sigma_i} = P_0 e^{(\theta-r)T}\sqrt{T}\left[\frac{\partial N(d1)}{\partial d1}\frac{\partial\sigma_P}{\partial\sigma_i} - \sqrt{T}e^{(\theta-r)T}N(-d1)\frac{\partial\theta}{\partial\sigma_i}\right] \qquad [8]$$

The effect on the put option price now depends on both the derivative of the local price and of the risk neutral rate with respect to the volatility of the futures price and exchange rate. The sign of [8] is positive if $\frac{\partial N(d1)}{\partial d1}\frac{\partial \sigma_P}{\partial \sigma_i} > \sqrt{T}e^{(\theta-r)T}\frac{\partial \theta}{\partial \sigma_i}N(-d1)$, otherwise, it is negative.

The sign of the derivative of $\theta$ depends on the correlation between futures and exchange rate since $\frac{\partial \theta}{\partial \sigma_i} = \rho_{F,E}\ \sigma_j$ , where $i, j\ \in (Future\ Price, Exchange\ Rate), i \neq j$. In our data, the values of $\rho_{F,E}$ for each location and crop are negative. Since all other variables inside the square brackets in [8] are positive, a negative $\rho_{F,E}$ implies that the sign of [8] depends on $\frac{\partial \sigma_P}{\partial \sigma_i}$. A positive derivative $\frac{\partial \sigma_P}{\partial \sigma_i}$, given $\rho_{F,E} < 0$ has a positive effect on put prices. If $\rho_{F,E} > 0$, the effect is positive if $\frac{\partial N(d1)}{\partial d1}\frac{\partial \sigma_P}{\partial \sigma_i} > \sqrt{T}e^{(\theta-r)T}N(-d1)\frac{\partial \theta}{\partial \sigma_i}$, and negative otherwise.

Using the same definition for subscripts, $\frac{\partial \sigma_P}{\partial \sigma_i} = (\frac{FE}{P})^2(2\sigma_i + \rho_{F,E}\ \sigma_j) + (\frac{FEB}{P^2})(\rho_{i,B}\ \sigma_B)$. The sign of $\frac{\partial \sigma_P}{\partial \sigma_i} \lesseqgtr 0$ is the same as $\frac{FE}{B}\left(2\sigma_i + \rho_{F,E}\ \sigma_j\right) \lesseqgtr -\rho_{F,B}\ \sigma_B$. It depends on the signs and magnitudes of $\rho_{F,E}\ \sigma_j$ and $\rho_{F,B}\ \sigma_B$. It is positive if both correlations, $\rho_{F,E}$ and $\rho_{F,B}$, are positive. This implies that by having positive correlations, the risk of the components cannot be mitigated and so this increases local price risk. If both $\rho_{F,E} < 0$ and $\rho_{F,B} < 0$, as with most of our data, the derivative is negative if $-\rho_{F,E}\ \sigma_j > 2\sigma_i$, or if $-\rho_{F,B}\ \sigma_B > \frac{FE}{B}\left(2\sigma_i + \rho_{F,E}\ \sigma_j\right)$; and likewise, a positive derivative occurs if $\frac{FE}{B}\left(2\sigma_i + \rho_{F,E}\ \sigma_j\right) > -\rho_{F,B}\ \sigma_B$. In the case where one correlation is positive and the other negative, or one being zero and the other non-zero, the effect on the sign of $\frac{\partial \sigma_P}{\partial \sigma_i}$ is given by the interaction with the rest of the variables of the equation. In general, the effect is positive if $\rho_{F,B} \geq 0$ and $\rho_{F,E} < 0$, when $2\sigma_F > \rho_{F,E}\sigma_E$.

Our data shows positive derivative of local price risk with respect to futures price and exchange rate volatility. This effect on the put option price is also positive. The negative correlation $\rho_{F,E}$ certainly contributes to this result. Also, from our data $\sigma_B$ is more than 60 times $\sigma_E$, and more than 6 times $\sigma_F$, which again, contributes to the positive effect of $\frac{\partial \sigma_P}{\partial \sigma_i}$.

***Data***

Local prices in Mexico are determined by the nearby futures price at the CME plus basis accounting for transportation costs and local demand and supply conditions. The price data used in this research are cash prices paid to producers in Mexico of three commodities: yellow corn, white corn, and sorghum. These grain prices at various locations were obtained through Grupo Consultor de Mecados Agricolas, S.A. de C.V., a consulting company specialized in agricultural markets in Mexico. Although local prices in Mexico are not recorded systematically by official sources, it is estimated by the law of one price by adding transportation and handling costs from a US port to a desired local market. This method of estimation is done by the government in order to establish a price for its programs and subsidies; in this same way large grain buyers calculate their offer prices to producers. The exchange rate and the risk free rate were obtained from the Mexican Central Bank (Banco de Mexico).

The closing price of the IPC and the futures price of yellow corn were obtained from Thomson Reuters' DataStream service. The data available for this research represents 13 local markets distributed in nine states. These markets are located in major production regions. The main corn producing states for both varieties of corn are Sinaloa (Sin), Jalisco (Jal), and Mexico State (Mex). This relationship has been steady for the past years. In 2010, the state of Sinaloa produced 22.4% of total national corn production, Jalisco 14.5% and the State of Mexico 6.6%.

Table 3.1 States with their Local Markets and Commodity

| State | Local Market | Commodity |
|---|---|---|
| Campeche (Camp) | Campeche | Corn |
| Chiapas (Chis) | Tuxtla Gutierrez | Corn |
| | Arriaga | Corn |
| | Tapachula | Corn |
| Chihuahua (Chih) | Chihuahua | Corn |
| Mexico (Mex) | Toluca | Corn |
| Guanajuato (Gto) | Irapuato | Corn, Sorghum |
| Jalisco (Jal) | Guadalajara | Corn, Sorghum |
| Michoacán (Mich) | Morelia | Corn, Sorghum |
| Sinaloa (Sin) | Culiacan | Corn, Sorghum |
| | Mochis | Corn, Sorghum |
| Tamaulipas (Tamps) | Victoria | Corn, Sorghum |
| | Matamoros | Corn, Sorghum |

Sorghum production is more concentrated than corn production. In 2007 the main producer was the state of Tamaulipas (Tamps) with over 40% of total national production. The main five producing states account for over 83% of total sorghum production, while in the case of corn they account for 57%.

*Local Cash Prices*

For the analysis of the Mexican market, daily prices of corn (white and yellow) and sorghum consisting of 1,370 observations were used from July/18/2003 to Dec/31/2007 [3]. Cash prices were estimated by the consulting company for 13 locations nationwide for both varieties of corn, and a subset of 7 locations for sorghum. These prices are paid to the farmer at the elevator, which are greatly affected by the US corn price, exchange rate and transportation cost.

Among the three commodities, yellow corn is the most commonly traded in a futures exchange. In the case of white corn, the South African Futures Exchange is the only exchange that trades its futures contracts. Sorghum futures are traded at the Australian Securities Exchange. White corn is generally priced higher than yellow corn and sorghum priced lower, but in general the price of white corn and sorghum are strongly correlated with that of yellow corn in the futures market. In Mexico the nearby future contract price of yellow corn at the CME (CBOT before) is used as a reference for both white corn and sorghum subject to local demand and supply conditions.

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[3] After revising the data we found some inconsistencies that are attributable to typographical errors in the record of cash prices. Only one location, Morelia, was found to have typos, for white and yellow corn during the interval of Aug/1/2006 through Aug/17/2006. There was a very large discrepancy in the price difference with respect to a major market, Guadalajara. The price difference of white corn in those markets had been consistent at $21.7 mxp/ton higher in Guadalajara, but during ten days of that time interval the price ranged from $341 to $724 mxp/ton higher in Morelia. This difference could be offset by transporting the commodity from nearby markets according to the Law of One Price. We find no justification for that price difference when it had been constant throughout the time series. Those prices were corrected using the usual price difference between markets of $21.7 mxp/ton.

*Brownian Motion and Stationarity*

One of the conditions for pricing derivatives using the Black-Scholes framework is that asset prices follow a geometric Brownian motion (GBM). Failure to meet this criterion gives biased results. A closely related condition for analyzing financial time series is that they be stationary. Spurious correlation results when two non-stationary time series are analyzed together. In finance we are interested in the return of assets, thus the stationary condition is applied to time series of returns. A GBM is a type of random walk with independent increments; although a GBM is not stationary, its increments are.(Tsay, 2005).

We tested for GBM in each time series by estimating its Hurst coefficient through a scaled variance ratio test (See Turvey 2007; Weron 2002; Schepers, VanBeek, Bassinsthwaite 1992; Lo and Mackinlay 1988). A Hurst coefficient (H) not different from 0.5 is a sufficient proof of Brownian motion, which also implies that the time series return has a unit root with an AR(1) process. A fractional process (H not equal to 0.5) is one with a unit root over an AR(q) process. We obtained the Hurst coefficients for each of our time series, and then compared them to the 90% confidence level estimated by Turvey (2007) for N= 1370, significantly more than the N= $2^9$ suggested by Cannon et al. (1997) for unbiased results.

In general, most time series at each location has a Hurst value within the 90% interval. Only two locations, Culiacan and Mochis, both from the state of Sinaloa and both for yellow corn have the only values that lay outside the 90% level; however, they lay within the 95% level. For most locations, yellow corn has the lowest Hurst value, followed by white corn and sorghum with the highest value. Given the sample size and number of lags, the Hurst coefficient values at the 90% confidence level lies between 0.5529 and 0.4470; at 95% is between 0.5631 and 0.4368; and at 99% between 0.5832 and 0.4167.

The Hurst values for the change in local basis were estimated at three locations, Guadalajara, Culiacan and Matamoros, because they represent major grain producing regions. The local basis for yellow corn at all locations has Hurst values below the 99% level. This is the only crop which basis has insignificant Hurst values. White corn and sorghum are within the 90% confidence interval, except for the local basis of sorghum at Matamoros, which is in the 95% level. We are not sure why the local basis for yellow corn indicates mean reversion, but speculate that because basis is comprised mostly of transportation costs, which are almost constant through time due to the rigidity of gas prices in Mexico, local supply and demand conditions may have a stronger effect on local basis for white corn and sorghum, on top of transportation costs.

Table 3.2 Estimated Hurst coefficients of local prices

| Market | Yellow Corn | White Corn | Sorghum |
|---|---|---|---|
| Campeche, Camp. | 0.4622 | 0.4558 | |
| Tuxtla Gutierrez, Chis. | 0.4586 | 0.4491 | |
| Arriaga, Chis. | 0.4573 | 0.4522 | |
| Tapachula, Chis. | 0.4557 | 0.4506 | |
| Cihuahua, Chih. | 0.4598 | 0.4617 | |
| Toluca, Mex. | 0.4567 | 0.4610 | |
| Irapuato, Gto. | 0.4637 | 0.4708 | 0.4862 |
| Guadalajara, Jal. | 0.4698 | 0.4731 | 0.4926 |
| Morelia, Mich. | 0.4625 | 0.4659 | 0.4942 |
| Culiacan, Sin. | *0.4423 | 0.4612 | 0.4705 |
| Mochis, Sin. | *0.4419 | 0.4639 | 0.4718 |
| Victoria, Tamps. | 0.4702 | 0.4691 | 0.5151 |
| Matamoros, Tamps. | 0.4685 | 0.4678 | 0.5116 |

Table 3.3 Estimated Hurst coefficients of local basis

| Market | Yellow Corn Basis | White Corn Basis | Sorghum Basis |
|---|---|---|---|
| Guadalajara, Jal. | 0.3820 | 0.4815 | 0.4878 |
| Culiacan, Sin. | 0.3887 | 0.4574 | 0.4605 |
| Matamoros, Tamps. | 0.4088 | 0.4922 | 0.4181 |

We also analyzed the behavior of the time series data from international markets. The prices from institutional markets have Hurst values within the 90% confidence level, and quickly converges to 0.5 as would be expected for complete and perfect markets. Futures price of yellow corn has a value of 0.5031, and it stays about 0.5 throughout the whole time interval. Foreign exchange has an estimated Hurst coefficient of 0.4598 at lag 37, but may be mean reverting at longer scales because of government policies regarding foreign exchange parity. In any case, our results show that the exchange rate is not a significant source of risk for pricing options in our model and appears to satisfy the properties of GBM at local scale of 37 lags. In addition, local cash prices already incorporate exchange rate, basis and futures risk, and almost all of them follow a Brownian motion within the 90% confidence level.

Figure 3.1 shows the time series of corn futures, and the local price at Guadalajara of sorghum (S), white corn (WC), and yellow corn (YC). All prices are in Mexican peso per ton. The similitude in price movement across all series is evident and reflects the substitutability across crops and the market integration with the US. Jaramillo, Yunez-Naude and Serrano-Cote (2012) show that this integration has increased since NAFTA took place in 1994, specifically for corn and sorghum. They also conclude that the speed of price adjustment has increased as well since 1994.

The strength of this integration is illustrated by a simple OLS regression. Results show that on average a \$1 usd increase in corn futures translates to a 5.04 peso increase in yellow corn ($R^2$= 0.93), 6.92 peso increase in white corn ($R^2$= 0.87), and 4.99 peso increase in sorghum ($R^2$= 0.91) in Guadalajara. Similar strengths of price transmission were found at all localities. With an average exchange rate of 10.92 mxp / usd, local price changes do not correspond to an equivalent contemporary change in futures prices.

It can be appreciated that throughout the time period the future price of corn has the lowest price per ton, and white corn the highest. The price difference between yellow corn and sorghum is not very clear, however, yellow corn seems to be priced a little higher than sorghum. It is important to note that agricultural commodities imports to Mexico have been gradually decreasing since January 1994 when NAFTA took effect. The tariff rate quotas to corn and other agricultural commodities imposed by the Mexican government were finally eliminated in January 2008. However, as Yunez-Naude (2011) argue, there was no import tariffs charged for corn imports even when the amount imported was higher than the established quotas. Following this, he concludes that it can be said that starting in 1994 corn has been imported duty free into Mexico.

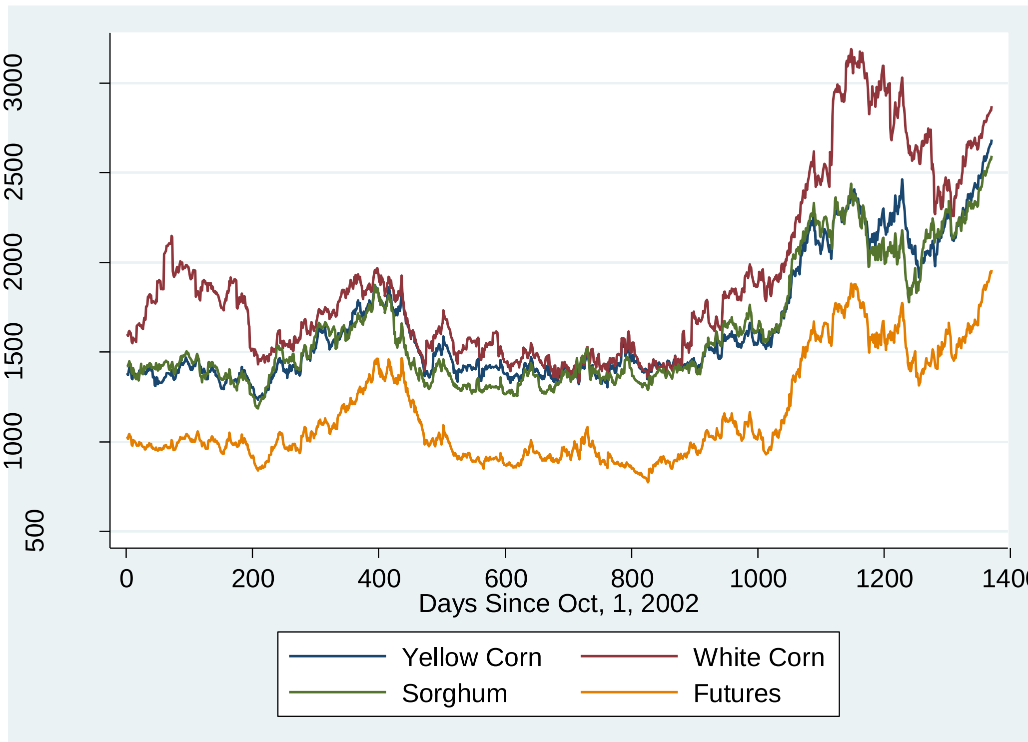


Figure 3.1 Time series of sorghum, white and yellow corn in Guadalajara and yellow corn futures in Mexican pesos per ton.

*Data Summary Statistics*

We use the annualized returns of the Mexican stock exchange index, IPC, for the Mexican market return. The time period of the data was from October 1st 2002 to December 31st 2007. Local prices were only available throughout this period; all other time series were obtained for the same time period to be consistent. They summed up 1,370 daily observations. The average return on the Mexican market is 24.55% with a standard deviation of 18.72%. This was an unusual high growth period prior to the subprime housing market in the US. At the time of the option valuations, the risk free rate in Mexico was 7.64%. For this we used the return on Cetes28, which is the 28-day government bond. From the sample of cash prices white corn has the largest average price and standard deviation: 488.97 compared to 345.63 of yellow corn, and 342.5 of sorghum. The lowest domestic prices for grains are in those locations that are large producers or that are close to the US border or to a seaport

For the sample period all three crops, yellow corn, white corn and sorghum showed an average annual price growth of 13.68%, 11.23% and 10.80%, and their average volatilities were 24.17%, 29.13 and 24.43% for yellow corn, white corn and sorghum respectively.  Among all markets, Matamoros has the largest volatility for yellow and white corn with 28.74% and 33.41% respectively, while the market with the lowest volatility for yellow corn is Guadalajara at 22.25% and for white corn Tapachula at 27.53%. In the case of yellow corn, the market with the lowest annual growth rate is Culiacan at 11.86%, and the highest is Tuxtla Gutierrez at 15.60%. The lowest average price for yellow corn is Matamoros, bordering with Brownsville, TX, at $1,333 mxp/ton; while Guadalajara showed the highest at $1,641 mxp/ton.

Table 3.4.Sample statistics of local commodities' prices (mxp / ton).

| Commodity | Market (city, state) | Average Price | Std. Deviation | Max | Min | Annual Growth Rate | Annual Volatility |
|---|---|---|---|---|---|---|---|
| **Yellow Corn** | Campeche, Camp. | 1530.54 | 343.67 | 2561.30 | 1066.42 | 0.14154 | 0.23865 |
| | Tuxtla Gutierrez, Chis. | 1524.21 | 381.55 | 2623.25 | 1009.99 | 0.15602 | 0.23601 |
| | Arriaga, Chis. | 1455.22 | 358.05 | 2466.04 | 969.32 | 0.15146 | 0.24579 |
| | Tapachula, Chis. | 1516.34 | 353.37 | 2522.24 | 1049.25 | 0.14257 | 0.23645 |
| | Cihuahua, Chih. | 1507.69 | 336.01 | 2510.62 | 1068.71 | 0.13139 | 0.25400 |
| | Toluca, Mex. | 1632.57 | 360.14 | 2685.93 | 1178.84 | 0.13365 | 0.22602 |
| | Irapuato, Gto. | 1596.35 | 333.71 | 2633.68 | 1202.59 | 0.12304 | 0.23096 |
| | Guadalajara, Jal. | 1641.76 | 341.30 | 2684.48 | 1233.59 | 0.12237 | 0.22245 |
| | Morelia, Mich. | 1622.55 | 338.91 | 2669.62 | 1211.89 | 0.12426 | 0.22660 |
| | Culiacan, Sin. | 1556.35 | 341.17 | 2641.62 | 1207.40 | 0.11875 | 0.23889 |
| | Mochis, Sin. | 1516.05 | 345.00 | 2606.02 | 1165.34 | 0.13073 | 0.24827 |
| | Victoria, Tamps. | 1520.90 | 330.35 | 2537.62 | 1155.62 | 0.12263 | 0.25080 |
| | Matamoros, Tamps. | 1333.25 | 329.99 | 2347.62 | 967.94 | 0.13686 | 0.28738 |
| **Yellow Corn All Locations** | | **1534.91** | **345.63** | **2576.16** | **1114.38** | **0.13348** | **0.24171** |
| **White Corn** | Campeche, Camp. | 1790.18 | 475.84 | 3009.65 | 1207.30 | 0.11722 | 0.28347 |
| | Tuxtla Gutierrez, Chis. | 1798.07 | 509.32 | 3091.67 | 1254.21 | 0.11518 | 0.27678 |
| | Arriaga, Chis. | 1731.87 | 495.97 | 2999.89 | 1187.56 | 0.11688 | 0.28510 |
| | Tapachula, Chis. | 1793.91 | 493.86 | 3056.07 | 1243.70 | 0.10842 | 0.27527 |
| | Cihuahua, Chih. | 1759.48 | 485.19 | 3084.68 | 1191.56 | 0.11676 | 0.29768 |
| | Toluca, Mex. | 1889.98 | 485.58 | 3155.15 | 1322.14 | 0.14482 | 0.27677 |
| | Irapuato, Gto. | 1831.63 | 485.31 | 3144.75 | 1283.85 | 0.10803 | 0.31662 |
| | Guadalajara, Jal. | 1875.70 | 491.54 | 3187.74 | 1333.53 | 0.10770 | 0.30745 |
| | Morelia, Mich. | 1872.77 | 482.52 | 3180.25 | 1319.10 | 0.10925 | 0.26647 |
| | Culiacan, Sin. | 1815.20 | 494.79 | 3130.42 | 1234.09 | 0.09551 | 0.28547 |
| | Mochis, Sin. | 1774.87 | 493.88 | 3096.11 | 1199.92 | 0.10499 | 0.28589 |
| | Victoria, Tamps. | 1783.05 | 481.51 | 3079.56 | 1186.07 | 0.10256 | 0.29625 |
| | Matamoros, Tamps. | 1595.44 | 481.27 | 2892.20 | 998.68 | 0.11266 | 0.33414 |
| **White Corn All Locations** | | **1793.24** | **488.97** | **3085.24** | **1227.82** | **0.112306** | **0.306081** |
| **Sorghum** | Irapuato, Gto. | 1585.93 | 336.18 | 2559.27 | 1164.11 | 0.10423 | 0.23871 |
| | Guadalajara, Jal. | 1620.02 | 340.87 | 2595.40 | 1186.40 | 0.11006 | 0.22853 |
| | Morelia, Mich. | 1604.76 | 341.95 | 2580.70 | 1164.19 | 0.11107 | 0.23128 |
| | Culiacan, Sin. | 1557.93 | 370.25 | 2588.70 | 1085.90 | 0.12299 | 0.24836 |
| | Mochis, Sin. | 1535.93 | 362.90 | 2553.70 | 1074.50 | 0.12209 | 0.25175 |
| | Matamoros, Tamps. | 1353.28 | 322.67 | 2255.70 | 953.97 | 0.09774 | 0.27233 |
| | Victoria, Tamps. | 1540.29 | 322.66 | 2442.70 | 1140.97 | 0.08810 | 0.23914 |
| **Sorghum All Locations** | | **1542.59** | **342.50** | **2510.88** | **1110.00** | **0.10804** | **0.24394** |

Table 3.5.Sample statistics of future prices and exchange rate.

| | Average | Std. Deviation | Max | Min | Annual Geometric Mean | Annual Volatility |
|---|---|---|---|---|---|---|
| Corn Futures | 266.28 | 65.32 | 455.50 | 186.25 | 0.10540 | 0.26778 |
| Exchange Rate (mxp / usd) | 10.92 | 0.33 | 11.68 | 9.94 | 0.01382 | 0.07310 |
| Futures MXP | 1145.50 | 284.38 | 1958.07 | 773.95 | 0.11922 | 0.27140 |

### *Results*

For each local market we estimated for every commodity (yellow and white corn and sorghum) the basis, standard deviation, growth rate, correlation (beta) with respect to the Mexican stock market index, and risk premium. These results are presented in tables 3.6 and 3.7.  Both types of corn have negative beta and risk premium for all locations. Sorghum show positive and negative beta and risk premium, depending on the location. The largest sorghum producing state, Tamaulipas, is among those locations with positive beta and risk premium. They are also the only ones, among all, that have negative basis growth. This may be because Matamoros is also a major port of entry for sorghum and other grains from the US, and transportation costs depend on the US basis and not so much on Mexican energy prices. We estimated quanto put prices for all locations at different levels of coverage with respect to the cash price. These results take into account basis risk, and thus each location has its own quanto price. Strike prices for the options were assigned at 80, 100 and 120% of the local price of each commodity measured in December, 31, 2007. Prices are in MXP per ton and time to maturity is one year. For simplicity we set the carrying costs, $\delta$, to zero. These prices are shown from tables 3.8 to 3.10, for yellow corn, white corn and sorghum, respectively.

For all locations, quantos for white corn are valued the highest for every coverage level. Sorghum quantos are higher than those for yellow corn at every location and coverage, even for the sorghum producing regions. Indeed, markets in Tamaulipas have the highest quanto prices for sorghum and yellow corn. For white corn, they are second and fourth, just below Irapuato, and Guadalajara.

If we compare quanto prices relative to the cash price at each location, those with the highest absolute priced options are also the ones with the highest relative quanto price. For yellow corn, quantos at 100% coverage of local price are valued between 3.8 and 6.9% of local prices. At 120% coverage, the relative prices range from 12.3 to 19.6%, and for 80% coverage the range is between 0.5 and 1.5%. White corn quantos at 100% coverage range from 5.1 to 9.2% of local price; at 120% coverage those values are 15.3 and 20%; and 0.7 and 2.8% for an 80% coverage level. For sorghum, at 100% coverage the range of relative prices is between 5.5 to 7.5%; at 120% coverage, 16 to 18.4%; and at 80% coverage, relative prices range from 0.8 to 1.7% of local prices.

Table 3.6.Basis estimation for yellow corn at each market.

| Commodity | Market (city, state) | Average Basis | Std. Deviation | Basis Growth Rate | Std. Deviation | Beta | Risk Premium |
|---|---|---|---|---|---|---|---|
| **Yellow Corn** | Campeche, Camp. | 385.04 | 116.80 | 0.2416 | 0.5726 | -0.0197 | -0.0043 |
| | Tuxtla Gutierrez, Chis. | 378.71 | 146.91 | 0.3514 | 0.5807 | -0.0082 | -0.0018 |
| | Arriaga, Chis. | 309.72 | 122.65 | 0.4005 | 0.7166 | -0.0099 | -0.0021 |
| | Tapachula, Chis. | 370.84 | 115.76 | 0.2596 | 0.5734 | -0.0059 | -0.0013 |
| | Cihuahua, Chih. | 362.19 | 95.41 | 0.1825 | 0.6545 | -0.0253 | -0.0055 |
| | Toluca, Mex. | 487.07 | 121.54 | 0.1793 | 0.4463 | -0.0137 | -0.0030 |
| | Irapuato, Gto. | 450.85 | 85.15 | 0.1346 | 0.4895 | -0.0262 | -0.0057 |
| | Guadalajara, Jal. | 496.26 | 94.73 | 0.1311 | 0.4513 | -0.0317 | -0.0069 |
| | Morelia, Mich. | 477.05 | 92.01 | 0.1389 | 0.4591 | -0.0255 | -0.0055 |
| | Culiacan, Sin. | 410.85 | 93.78 | 0.1174 | 0.6030 | -0.0376 | -0.0082 |
| | Mochis, Sin. | 370.55 | 97.65 | 0.1707 | 0.6953 | -0.0305 | -0.0066 |
| | Victoria, Tamps. | 375.40 | 77.87 | 0.1346 | 0.6346 | -0.0243 | -0.0053 |
| | Matamoros, Tamps. | 187.75 | 77.45 | 0.2669 | 1.5480 | -0.0232 | -0.0050 |
| **All Yellow Corn** | | **389.41** | **102.91** | **0.2084** | **0.6481** | **-0.0217** | **-0.0047** |

Table 3.7.Basis estimation for white corn and sorghum for each local market.

| Commodity | Market (city, state) | Average Basis | Std. Deviation | Basis Growth Rate | Std. Deviation | Beta | Risk Premium |
|---|---|---|---|---|---|---|---|
| **White Corn** | Campeche, Camp. | 644.68 | 230.79 | 0.1131 | 0.6565 | -0.0490 | -0.0106 |
| | Tuxtla Gutierrez, Chis. | 652.57 | 263.49 | 0.1075 | 0.6245 | -0.0359 | -0.0078 |
| | Arriaga, Chis. | 586.37 | 250.38 | 0.1119 | 0.6977 | -0.0423 | -0.0092 |
| | Tapachula, Chis. | 648.41 | 250.22 | 0.0883 | 0.6216 | -0.0352 | -0.0076 |
| | Cihuahua, Chih. | 613.98 | 244.88 | 0.1106 | 0.7132 | -0.0501 | -0.0109 |
| | Toluca, Mex. | 744.48 | 245.10 | 0.2114 | 0.6101 | -0.0486 | -0.0105 |
| | Irapuato, Gto. | 686.13 | 244.73 | 0.0849 | 0.7321 | -0.0517 | -0.0112 |
| | Guadalajara, Jal. | 730.20 | 251.45 | 0.0852 | 0.6844 | -0.0519 | -0.0112 |
| | Morelia, Mich. | 733.17 | 256.16 | 0.0892 | 0.8747 | -0.0337 | -0.0072 |
| | Culiacan, Sin. | 669.70 | 269.19 | 0.0514 | 0.6744 | -0.0583 | -0.0126 |
| | Mochis, Sin. | 629.37 | 263.96 | 0.0755 | 0.7137 | -0.0581 | -0.0126 |
| | Victoria, Tamps. | 637.55 | 251.09 | 0.0676 | 0.7208 | -0.0495 | -0.0107 |
| | Matamoros, Tamps. | 449.94 | 250.9553 | 0.0933 | 1.3257 | -0.0447 | -0.0097 |
| **All White Corn** | | **648.20** | **251.7265** | **0.0992** | **0.7422** | **-0.0468** | **-0.0101** |
| **Sorghum** | Irapuato, Gto. | 440.43 | 105.4572 | 0.0625 | 0.6607 | 0.0138 | 0.0030 |
| | Guadalajara, Jal. | 474.52 | 106.8381 | 0.0845 | 0.5747 | 0.0016 | 0.0003 |
| | Morelia, Mich. | 459.26 | 106.7082 | 0.0876 | 0.5930 | 0.0016 | 0.0003 |
| | Culiacan, Sin. | 412.43 | 134.2574 | 0.1352 | 0.8061 | -0.0196 | -0.0042 |
| | Mochis, Sin. | 390.43 | 125.4693 | 0.1318 | 0.8549 | -0.0192 | -0.0042 |
| | Matamoros, Tamps. | 207.78 | 107.8181 | -1.5226 | 3.4042 | 0.0050 | 0.0011 |
| | Victoria, Tamps. | 394.79 | 107.8075 | -0.0015 | 0.7527 | 0.0204 | 0.0044 |
| **All Sorghum** | | **397.09** | **113.47** | **-0.1461** | **1.0923** | **0.0005** | **0.0001** |

Table 3.8.Quanto put prices in mxp for yellow corn.

| Yellow Corn Market (city, state) | Local Price (Dec 31, 2007) 80% | 100% | 120% | Put Price 80% | 100% | 120% |
|---|---|---|---|---|---|---|
| Campeche, Camp. | 2049 | 2561 | 3073 | 19 | 121 | 362 |
| Tuxtla Gutierrez, Chis. | 2098 | 2623 | 3147 | 14 | 100 | 323 |
| Arriaga, Chis. | 1972 | 2466 | 2959 | 16 | 104 | 318 |
| Tapachula, Chis. | 2017 | 2522 | 3026 | 17 | 116 | 353 |
| Cihuahua, Chih. | 2008 | 2510 | 3012 | 26 | 143 | 394 |
| Toluca, Mex. | 2148 | 2685 | 3223 | 17 | 123 | 385 |
| Irapuato, Gto. | 2106 | 2633 | 3160 | 21 | 135 | 402 |
| Guadalajara, Jal. | 2147 | 2684 | 3221 | 18 | 130 | 400 |
| Morelia, Mich. | 2135 | 2669 | 3203 | 19 | 131 | 400 |
| Culiacan, Sin. | 2113 | 2641 | 3169 | 24 | 146 | 417 |
| Mochis, Sin. | 2084 | 2606 | 3127 | 25 | 143 | 402 |
| Matamoros, Tamps. | 1878 | 2347 | 2817 | 36 | 156 | 390 |
| Victoria, Tamps. | 2030 | 2537 | 3045 | 28 | 150 | 410 |

Table 3.9.Quanto put prices in mxp for white corn.

| White Corn Market (city, state) | Local Price (Dec 31, 2007) 80% | 100% | 120% | Put Price 80% | 100% | 120% |
|---|---|---|---|---|---|---|
| Campeche, Camp. | 2327 | 2909 | 3490 | 48 | 205 | 506 |
| Tuxtla Gutierrez, Chis. | 2370 | 2962 | 3555 | 46 | 204 | 512 |
| Arriaga, Chis. | 2296 | 2871 | 3445 | 48 | 205 | 503 |
| Tapachula, Chis. | 2341 | 2927 | 3512 | 46 | 206 | 515 |
| Cihuahua, Chih. | 2185 | 2732 | 3278 | 53 | 209 | 495 |
| Toluca, Mex. | 2337 | 2922 | 3506 | 35 | 170 | 446 |
| Irapuato, Gto. | 2256 | 2821 | 3385 | 68 | 242 | 543 |
| Guadalajara, Jal. | 2297 | 2872 | 3446 | 64 | 236 | 542 |
| Morelia, Mich. | 2285 | 2857 | 3428 | 21 | 148 | 445 |
| Culiacan, Sin. | 2264 | 2830 | 3396 | 54 | 220 | 527 |
| Mochis, Sin. | 2235 | 2794 | 3353 | 51 | 211 | 508 |
| Matamoros, Tamps. | 2061 | 2576 | 3092 | 72 | 237 | 514 |
| Victoria, Tamps. | 2213 | 2766 | 3320 | 57 | 222 | 520 |

Table 3.10.Quanto put prices in mxp for sorghum.

| Sorghum Market (city, state) | Local Price (Dec 31, 2007) | | | Put Price | | |
|---|---|---|---|---|---|---|
| | 80% | 100% | 120% | 80% | 100% | 120% |
| Irapuato, Gto. | 2047 | 2559 | 3071 | 27 | 155 | 431 |
| Guadalajara, Jal. | 2076 | 2595 | 3114 | 22 | 143 | 417 |
| Morelia, Mich. | 2064 | 2580 | 3096 | 23 | 144 | 416 |
| Culiacan, Sin. | 2070 | 2588 | 3106 | 27 | 150 | 415 |
| Mochis, Sin. | 2042 | 2553 | 3064 | 28 | 152 | 415 |
| Matamoros, Tamps. | 1804 | 2255 | 2706 | 38 | 168 | 415 |
| Victoria, Tamps. | 1954 | 2442 | 2931 | 29 | 159 | 431 |

### *Validation*

How different are our option prices with respect to the option prices quoted at a commodities exchange? To validate the relative price of our estimated options, we divided the option price at each level of coverage by the current local price for each location. Table 3.11 shows the relative option prices at each location and at the CME commodities exchange. The relative price for the CME options was obtained by dividing the option price for yellow corn by the nearby futures contract price. Quanto prices for yellow corn are cheaper in Mexico than those quoted using futures prices at the CME; the only exception is Matamoros at 80% coverage level. The quanto price is 1.5 % of the local price in Matamoros and 1% at the CME. Relative price of put options for White corn at 120% are higher in the CME than in most locations in Mexico; however, prices in Mexico can be higher for some locations at 100% coverage, but they are higher at all locations at 80% coverage. Sorghum relative prices have mixed values with respect to CME prices. For 120% coverage, the CME price is higher than any location in Mexico. At 100% coverage, the relative price in Matamoros is more expensive, while at 80% coverage, Mochis, Matamoros and Victoria are higher, and Culiacan the same than the CME relative prices. This comparison does not take into account local basis in the US. It was shown just as an illustration and also to verify that the estimated prices in Mexico are in accordance to the prices at the futures market.

Table 3.11.Relative prices of options as percentage of local prices for different coverage levels.

| | **Put Price / Cash Price Yellow Corn** | | | **Put Price / Cash Price White Corn** | | | **Put Price / Cash Price Sorghum** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Market (city, state)** | **80%** | **100%** | **120%** | **80%** | **100%** | **120%** | **80%** | **100%** | **120%** |
| CME (Futures Exchange) | 0.010 | 0.069 | 0.196 | | | | | | |
| Campeche, Camp. | 0.007 | 0.047 | 0.141 | 0.017 | 0.070 | 0.174 | | | |
| Tuxtla Gutierrez, Chis. | 0.005 | 0.038 | 0.123 | 0.016 | 0.069 | 0.173 | | | |
| Arriaga, Chis. | 0.006 | 0.042 | 0.129 | 0.017 | 0.071 | 0.175 | | | |
| Tapachula, Chis. | 0.007 | 0.046 | 0.140 | 0.016 | 0.070 | 0.176 | | | |
| Cihuahua, Chih. | 0.010 | 0.057 | 0.157 | 0.019 | 0.077 | 0.181 | | | |
| Toluca, Mex. | 0.006 | 0.046 | 0.143 | 0.012 | 0.058 | 0.153 | | | |
| Irapuato, Gto. | 0.008 | 0.051 | 0.153 | 0.024 | 0.086 | 0.192 | 0.011 | 0.061 | 0.168 |
| Guadalajara, Jal. | 0.007 | 0.048 | 0.149 | 0.022 | 0.082 | 0.189 | 0.008 | 0.055 | 0.161 |
| Morelia, Mich. | 0.007 | 0.049 | 0.150 | 0.007 | 0.051 | 0.156 | 0.009 | 0.056 | 0.161 |
| Culiacan, Sin. | 0.009 | 0.055 | 0.158 | 0.019 | 0.078 | 0.186 | 0.010 | 0.058 | 0.160 |
| Mochis, Sin. | 0.010 | 0.055 | 0.154 | 0.018 | 0.076 | 0.182 | 0.011 | 0.060 | 0.163 |
| Matamoros, Tamps. | 0.015 | 0.066 | 0.166 | 0.028 | 0.092 | 0.200 | 0.017 | 0.075 | 0.184 |
| Victoria, Tamps. | 0.011 | 0.059 | 0.162 | 0.021 | 0.080 | 0.188 | 0.012 | 0.065 | 0.176 |

### *Conclusion*

In response to calls for more market oriented approaches to price risk management in developing economies, this paper develops a dual currency financial derivative model, called quanto, to investigate a market-based price insurance product for grain farmers at various locations in Mexico. A quanto option is used when the underlying asset is priced in a currency different from its payoffs, but where the local price is dependent on the price in another country. In our paper, the underlying commodity is yellow corn futures quoted at the CME in USD, with payoffs in Mexican pesos. We were able to price the quanto options since local grain prices in Mexico are correlated to the price of futures corn contracts in the US. By knowing the price of the futures corn contracts, exchange rate and local basis for each crop we were able to price put options for yellow corn, white corn and sorghum at 13 locations throughout Mexico. The relative prices of our quanto options are consistent with the option prices traded at the CME. Differences in prices are due to the extra sources of risk that developing countries face but captured in our model.

As indicated, the advantage that this model presents to current approaches to price stabilization in Mexico is that its pricing mechanism is market based. The current Mexican price guarantee program, *Programa de Administración de Riesgos de Mercados a Través de los Intermediarios Financieros* (PARMIF) does not cover all products (currently only options for corn, sorghum and wheat are available), and being a government program the inclusion of new crops depends on the lobbying capacity of producers. Through this model, we are able to price put options for different crops if their local price is correlated to a futures price in a foreign market. The futures price need not be the same crop in the domestic market, as in the case of sorghum in Mexico, we were able to price the options because its local prices are correlated to that of yellow corn in the CME. This characteristic allows us to price options for any commodity anywhere as long as the correlation condition is met. Another advantage that this model presents is that by incorporating local basis risk, it provides a better hedging model than by just buying two options on the market, one for the crop and another one for the exchange rate risk.

This quanto model is not limited to European options, but can be used to price path dependent options like Asians or Barrier options. Call prices can also be estimated. Furthermore, due to the simplicity of this model it can be pilot tested for selected crops and regions given any level of coverage if the risk factors are measurable, that is, if the correlation between local and futures price is sufficiently large. This conforms to the World Bank sets of policy priorities for agricultural and rural development.

***Appendix***

1.*The quanto's vega*, $\frac{df_p}{d\sigma_p}$, is:

$$\frac{df_p}{d\sigma_p} = Ke^{(-rT)}\frac{\partial N(-d2)}{\partial d2}\frac{\partial d2}{\partial \sigma_p} - P_0\, e^{(\theta-r)T}\frac{\partial N(-d1)}{\partial d1}\frac{\partial d1}{\partial \sigma_p}$$

We know that,

$\frac{\partial N(di)}{\partial di} = \frac{1}{\sqrt{2\pi}}e^{\left(-\frac{di^2}{2}\right)}$, for $i \in (1,2)$; $\frac{dd1}{d\sigma p} = \sqrt{T} - \left[\frac{\ln\left(\frac{P}{K}\right)+T\left(\frac{\sigma p^2}{2}+\theta\right)}{\sigma p^2\sqrt{T}}\right]$, and

$\frac{dd2}{d\sigma p} = -\left[\frac{\ln\left(\frac{P}{K}\right)+T\left(\frac{\sigma p^2}{2}+\theta\right)}{\sigma p^2\sqrt{T}}\right]$ from which we obtain:

$$-Ke^{(-rT)}\frac{1}{\sqrt{2\pi}}e^{\left(-\frac{d1^2}{2}\right)}e^{(\theta T)}\frac{P_0}{K}\left\{-\left[\frac{\ln\left(\frac{P_0}{K}\right)+T\left(\frac{\sigma p^2}{2}+\theta\right)}{\sigma p^2\sqrt{T}}\right]\right\} + P_0\, e^{(\theta-r)T}\frac{1}{\sqrt{2\pi}}e^{\left(-\frac{d1^2}{2}\right)}\left\{\sqrt{T} - \left[\frac{\ln\left(\frac{P_0}{K}\right)+T\left(\frac{\sigma p^2}{2}+\theta\right)}{\sigma_p^2\sqrt{T}}\right]\right\}$$

Simplyfies to,

$$P_0\sqrt{T}e^{(\theta-r)T}\frac{1}{\sqrt{2\pi}}e^{\left(-\frac{d1^2}{2}\right)} > 0$$

2. The result of [8], $\frac{df_p}{d\sigma_i}$, where $i \in (Future\ Price, Exchange\ Rate)$ is:

$$e^{(-rT)}\frac{\partial N(-d2)}{\partial d2}\frac{\partial d2}{\partial \sigma_i} - [P_0 e^{(\theta-r)T}e^{(\theta-r)T}T\frac{\partial \theta}{\partial \sigma_i}N(-d1) + P_0 e^{(\theta-r)T}\frac{\partial N(-d1)}{\partial d1}\frac{\partial d1}{\partial \sigma_i}]$$

After expanding $\frac{\partial N(-d2)}{\partial d2}$ $and$ $\frac{\partial N(-d1)}{\partial d1}$,

$$-Ke^{(-rT)}\frac{1}{\sqrt{2\pi}}e^{\left(-\frac{d_1{}^2}{2}\right)}e^{(\theta T)}\frac{P_0}{K}\left(\frac{\partial d1}{\partial \sigma_i}-\frac{\partial \sigma_P}{\partial \sigma_i}\sqrt{T}\right)+P_0e^{(\theta-r)T}\frac{1}{\sqrt{2\pi}}e^{\left(-\frac{d_1{}^2}{2}\right)}\frac{\partial d1}{\partial \sigma_i}$$
$$-P_0e^{2(\theta-r)T}T\frac{\partial \theta}{\partial \sigma_i}N(-d1)$$

Simplifies to,

$$\frac{df_p}{d\sigma_i}=P_0e^{(\theta-r)T}\sqrt{T}[\frac{\partial N(d1)}{\partial d1}\frac{\partial \sigma_P}{\partial \sigma_i}-\sqrt{T}e^{(\theta-r)T}N(-d1)\frac{\partial \theta}{\partial \sigma_i}]$$

Where $\frac{\partial N(d1)}{\partial d1}=\frac{1}{\sqrt{2\pi}}e^{\left(-\frac{d_1{}^2}{2}\right)}$; $\frac{\partial \sigma_P}{\partial \sigma_i}=(\frac{FE}{P})^2(2\sigma_i+\rho_{F,E}\ \sigma_j)+(\frac{FEB}{P^2})(\rho_{i,B}\ \sigma_B)$

and $\frac{\partial \theta}{\partial \sigma_F}=\rho_{F,E}\ \sigma_E$; $\frac{\partial \theta}{\partial \sigma_E}=\rho_{F,E}\ \sigma_F$; $\frac{\partial \theta}{\partial \sigma_B}=0$

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# CHAPTER 4

## RISK RATIONING AND THE DEMAND FOR AGRICULTURAL CREDIT

***Abstract***

The purpose of this paper is to determine the extent of risk rationing amongst potential rural borrowers. Using data from 372 farmers in northeastern Mexico and 730 farm households in the Shaanxi province of China, we investigate factors associated with risk rationed, price rationed and quantity rationed farmers. This study compares the results of both surveys. The analysis applies both a linear probability and logit model. We find in China the incidence of risk rationing in farmers to be 6.5%, 14% for quantity rationed and 80% for price rationed. In Mexico, 35% of our sample is risk rationed, 10% quantity rationed and 55% price rationed. Our results from China support the hypothesis that financial poor are more likely to be quantity rationed; in Mexico however, the level of education is found to be important in determining quantity rationed. In both countries, asset wealthy farmers are less likely to be risk rationed; however, income doesn't appear to have an impact. We provide evidence that the elasticity of demand for credit is different among the three credit rationed groups: risk rationed, price rationed and quantity rationed. Risk aversion and prudence are significantly correlated with risk rationing in China, while only risk aversion is significant in Mexico. Our results suggest that efforts to enhance credit access must also deal with risk and risk perceptions.

***Introduction***

Credit rationing can be broadly categorized into three groups: risk rationing, price rationing and quantity rationing. The first two groups are determined by the producer, while quantity rationed is externally determined by the financial institution. Although in this study we analyzed all three types of credit rationing, our main interest is on those household characteristics that can help in understanding the determinants of risk rationing.

The decision to become risk rationed can depend on many factors. According to a definition of risk rationing proffered by Boucher, Carter and Guirkinger (2008) (BCG) "*Risk rationing occurs when **insurance markets are absent**, and lenders, constrained by **asymmetric information**, shift so much contractual risk to the borrower that the **borrower voluntarily withdraws** from the credit market even when he **has the collateral wealth needed to qualify for a loan contract***". This definition suggest that a risk rationed individual can only be classified as such if insurance markets are absent, adverse selection is present, and there is a real demand for credit; but in the absence of risk contingent markets of any sort, there is a withdrawal from the credit market in order to preserve collateral. From an economic point of view, the concept of risk rationing rounds out the various sources of credit constraints including quantity and price rationing. When considered in full, supply side quantity and price rationing, combined with demand side price and risk rationing round out all possible factors that might give rise to a positive shadow price on a farm household's credit constraint[2].At the heart of risk rationing is the partitioning of non-borrowers into those that do not borrow because of collateral risk and those that do not borrow because of they have no need[3]. Price rationed individuals' demand for credit depends on the current interest rate. Quantity rationing occurs when the lender does not lend because he deems the borrower to be unqualified for repayment.

Risk rationing, as a topic of inquiry, is critically important to understanding borrower behavior and credit decisions in agricultural development. The state of the art in the present study are theoretical postulates in which the entirety of risk rationing behavior is determined by the relationship between wealth, risk aversion and prudence. However, risk aversion and prudence are nebulous measures that arise in theory but are much more difficult to measure in reality. Nonetheless they are critical to the baseline understanding. However, there may be many other household characteristics that do not arise in theory that can also aid in distinguishes why one farmer might risk ration while another price rations. Arising from this are the problems of instrumentation and endogeneity. For example simply observing that a farm household has no formal debt does not imply either risk rationing or quantity rationing; It may simply be that debt is not needed or that debt is not used at the current rate of interest (i.e. price rationing). Consequently, designing appropriate, properly identified, instruments that are not endogenously determined by indeterminable factors requires great care.

In this study, we investigate risk rationing in rural Mexico and China. To accomplish this we designed the survey specifically to identify risk rationing, price rationing and quantity rationing so that the partitioning between the three is unambiguous. In doing so we avoid problems of identification, instrumentation and endogeneity and can then focus on determining relationships between independent/explanatory variables and risk, price and quantity rationing. Our use of a two-country panel is part of this approach. There are many country-specific characteristics that could explain risk rationing behavior including agricultural populations and culture, technology adoption, different political and credit systems and so on that may help in understanding differences in credit rationing in different countries. We thus employed identical surveys, the first being delivered in Chinese in Shaanxi China in November of 2010 and the second, prepared in Spanish, in San Luis Potosí, Mexico in September of 2011 . In the two surveys reported in this paper, we find that 6.5% of Chinese farmers and 35% of Mexican farmers are risk rationed. The China survey interviewed 730 farm households, while the Mexico study interviewed 372 small land owner [4].

This chapter synthesizes these two studies on risk rationing: China and Mexico. The results from the Chinese study were part of Sivalai Vararuth's (Khantachavana) Ph.D. dissertation (2012). The result of the two studies are also analyzed in Verteramo et al. (2013), coauthored by Vararuth. For the sake of consistency, and to facilitate the understanding of the organization of these two studies, some definitions of the conditions of risk rationing by BCG and the way they are presented and organized are transcribed from Vararuth (2012), with the permission of the author.

Our surveys were instrumented to specifically test the conjectures and hypotheses of risk rationing and to examine further endogenous relationships that might prove important to a deeper understanding of risk rationing. Our approach uses the direct elicitation methodology (DEM), where a set of questions directly elicits the household's status as either credit constrained versus unconstrained, and is similar to an approach recommended in Boucher, Guirkinger and Trivellini (2009). Endogenous characteristics that we estimate econometrically include credit demand and credit demand elasticities, informal lending, property rights, entrepreneurship, risk aversion, prudence, wealth, insurance markets and asymmetric information.

The paper proceeds as follows. In the next section we review related literature on credit demand and constraints. We then stipulate the hypotheses of interest from the definition of risk rationing by BCG, explain how these are instrumented with our approach, describe data and survey techniques, and end with results and discussion.

***Background and Related Research***

The central importance of BCG, and their related papers, is in the understanding of credit constraints in agricultural development. The idea that farmers will avoid credit risk is not new, but a formal treatment has been elusive. One of the earliest considerations from Roy (1952; see also Masson 1974) dealt with safety-first constraints. A farmer facing bankruptcy (i.e. loss of collateral) would minimize the probability of falling below a critical income level that would trigger the loss. The constraints on (linear) utility would be such that debt coverage is satisfied in all states of nature. On the relationship between credit constraints and agricultural productivity and rural livelihoods much has been written (Binswanger 1980; Binswanger and Sillers 1983; Carter 1988; Carter and Olinto 1993; Eswaran and Kotwal 1990; Kochar 1997a, 1997b) and with some discourse over the range of interventionist policies (Adams and Graham 1981; Adams and Von Pischke 1991; Carter 1988). An early sentiment of risk rationing is by Binswanger and Siller (1983) who state "*If the disutility of the loan is sufficiently high, small farmers may stop borrowing altogether, i.e. the credit market for small farmers may disappear because of lack of demand, despite the fact that small farmers may still have available collateral in the form of unencumbered land*" (page 17), and in concluding "*It is important to realize that it is not an innate deficiency in the willingness of small farmers to take risks that hold them back*" (page 19). Binswanger and Siller see an inverse incidence of risk rationing to asset size. This is because, collateral is assumed to be divisible so that interest and collateral are viewed as substitutes (as in Bester 1985). In reality, loss of collateral is an all or one proposition as developed in Roy (1952) and Masson (1974). If the fixity of collateral is considered then the larger farm would have proportionately more to lose with the same level of risk and would view asset risk with greater prudence.

Eswaran and Kotwal (1990) examine credit constraints using a two-period consumption model to explain why the risk premium declines with wealth. Then they state that "*this theory thus may dispense with the need for an assumption involving the third order derivative of the von Neumann-Morgenstern utility function*" (page 478), that is, prudence[5]. This seems to say that the ability to use credit markets to smooth consumption between individuals of different income classes but identical utility functions can be differentiated by scale of operations in terms of credit demand. However, Eswaren and Kotwal (1990) conclude that under their original assumptions "*the poor are reluctant to become residual claimants (i.e. equity owners); they would rather work for fixed wages that are lower than the expected values they could earn as residual claimants. What seems like an inordinate degree of risk aversion may be a* *merely a reflection of their inability to sustain downswings in income*" (Page 480). Under the current definition of risk rationing, however, an increased prudence of the wealthy can lead them to behave as risk rationed. With different points of view, whether risk aversion, prudence and wealth matter independently or jointly is an empirical matter that we test in this paper.

Bell, Srintvasan and Udry (1997) examining credit demand with linked (e.g. a contractual relation with a marketer offering a loan to be repaid with commodity delivery) and unlinked (regulated cooperatives) credit estimate a credit demand relationship in which demand increases with liquid assets but decreases with fixed assets, a result they state is "*both puzzling and unsatisfactory*" (page 575). That the sign on liquid assets is positive is at least suggestive of risk rationing behavior, since liquid assets would buffer (in a precautionary and prudent way) the collateralized value of fixed assets in case of default. However, Bell, Srintvasan and Udry (1997) find that credit demand for the unregulated market has a positive sign, suggesting that higher land assets held more informal debt than formal debt perhaps because the latter would have a claim on the land itself, whereas the informal, unregulated market, would not. While it is naturally difficult to reinterpret such results, it appears on the surface that Bell, Srintvasan and Udry (1997) also show evidence of risk rationing in the Punjab. However, Swain (2002), investigating credit rationing in Puri, India, finds evidence of credit rationing in the conventional sense, but also notes that "*the lower number of households demanding loans from the formal sector might be a choice decision of the household… Such households restrict their demand for production loans even if they have access to them*" (Pages 4-5). Bhattacharyya (2005) reveals data from West Bengal showing that even in the presence of formal lending, 62.3% of farmers used informal credit with 86% of these willing to pay a substantial premium for not having to give up collateral[6].

Placing the above research in context it becomes clear that an important (and missing) aspect of risk rationing is how it affects or explains credit demand. The true demand will be different from the notional demand, but only the latter is actually observable. Kochar (1997) and Bell (1990) make the broad conclusion that notional demand is low given access to informal credit and that the benefits derived from credit policies may be limited. It is worth noting that of Kochar's (1997) sample only 34.7% borrowed either formally (20%) or informally (17.2%), leaving 45.3% non-borrowers unidentified as to the reasons. If the results reported here for China and Mexico are any indication of the degree of risk rationing in a rural population; then, conclusions that credit policies are ineffective can be misleading. In a statistical framework, the risk rationed can easily be mistaken for borrowers with a perfectly inelastic demand for credit at zero, which when aggregated across all borrowers will arithmetically result in an inelastic aggregate demand. But this is not the case at the micro level. In China, for example, Turvey et al. (2011) show that about 20% of households have highly inelastic demands for credit (less than -0.25). Many of these households had no demand for debt and thus had perfectly inelastic demands. However, nearly 50% of households had demand elasticities in excess of -0.50 and nearly 20% with elasticities greater than -0.75. About 15% of households had demand elasticities greater than -1.0. Salazar, Bogan and Turvey (2010) find a similar distribution of microcredit borrowers in the Dominican Republic with an average elasticity across borrowers of -1.0. In both papers there is evidence that the demand becomes more elastic as interest rates fall. The point is that the broader view of credit policies needs to be investigated in the context of borrower characteristics (Braverman and Guasch 1986). This is a difficult task as illustrated in Binswanger and Khandker (1993) who, upon investigating a supply leading approach to rural credit in India, could not conclude whether India's programs were successful or not. The identification of risk rationing suggests that farmers are not passive or irrational, but prudent actors. Nonetheless, only recently have approaches to new credit instruments that deal directly with collateral preserving credit instruments that would be attractive to risk rationed farm households been considered (Galarza and Carter 2010; Carter 2011, Miranda and Gonzalez-Vega 2011, Collier 2011; Karlan et al. 2011; Shee and Turvey 2012).

***Hypotheses on Risk Rationing***

The hypotheses about risk rationing emerging from BCG are derived from a very specific utility model. Since we do not alter their model (BCG, Pages 411-418) in any form we see no need to replicate it here, but instead provide its qualitative implications as conjecture and hypothesis. Addressing their model in this way also avoids the problem of having to jointly test the specifics of their model structure and the implications derived therefrom.

In the following paragraphs, and in the same spirit as Vararuth and Verteramo et al., we generalized on a more qualitative basis the BCG model implications for empirical assessment. Again, certain contents are transcribed from Vararuth (2012) and Verteramo et al. (2013) with the permission of the authors for the reasons previously mentioned.

### *Wealth-Biased Quantity Rationing*

Quantity rationing is decreasing in financial wealth and productive wealth. Financial wealth is liquid and can be committed as collateral to secure production loans. Productive wealth is land which can also be used as collateral. BCG shows that quantity rationing is unambiguously biased against the poor. An increase in financial wealth tends to relax quantity rationing, while an increase in an agent's land endowment, whether it is titled or untitled, will also relax quantity rationing.

### *Risk Rationing and Financial Wealth*

Following Thiele and Wambach (1999), BCG demonstrate that risk rationing may depend on the type of wealth considered. They obtain the results that the financial wealthy will be risk rationed. BCG argue that whether the financially poor or financially rich are risk rationed depend on the relative strength of two opposing effects from risk-aversion and incentive-dilution. The risk-aversion effect states that those agents who are more sensitive to risk would be more likely to be risk rationed (assuming decreasing absolute risk aversion (DARA)). The incentive-dilution effect states that financially wealthier agents are less sensitive to a given contractual risk and must then face riskier contracts than poorer agents in order to maintain incentive compatibility. Therefore, relatively rich agents might also display risk rationing behavior.

*Prudence and Risk Aversion*

Under proposition 2 in BCG (Page 416), risk rationing can be biased either for or against the financially wealthy but this is linked to the relationships between prudence (P), $-\frac{u'''(x)}{u''(x)}$, and risk aversion (A), $-\frac{u''(x)}{u'(x)}$. The idea that the financially wealthy can be risk rationed is therefore not so clear cut. BCG propose that if the coefficient of prudence is greater than three times the coefficient of risk aversion, then an agent with financial wealth will prefer commercial activity while the poor will prefer subsistence activity and be risk rationed. However, if prudence is less than three times risk aversion ( $P < 3A$), then the poor will prefer commercial activity while the rich will prefer subsistence activity and be risk rationed. The theoretical conclusions suggest that measures of prudence or risk aversion are less than perfectly correlated and in fact may be inversely related in order to identify degrees of risk rationing across wealth classes. Whether prudence and/or risk aversion influence risk rationing are complements, substitutes or neither is a testable hypothesis.

*The Relatively Land-Poor are Risk Rationed*

Here BCG argue that there is a relationship between risk rationing and productive wealth. The authors argue that exploiting the land with risky activity yields a higher return. As farm size increases, returning to safe activity becomes increasingly costly. The land-wealthy will choose to participate in the credit market and fully exploit their productive asset (land). Thus, against the null of no difference in risk rationing between farm households of different sizes, the effect of land size on risk rationing behavior is a testable hypothesis.

*Risk Rationing and Insurance Markets, Asymmetric Information and the Elasticity of Demand for Credit*

BCG argue that risk rationing occurs when insurance markets are absent; the agent would be offered and demand a credit contract in the symmetric information world; the agent is offered a financially feasible contract in the asymmetric information world, but the agent chooses not to accept the offered contract, preferring the reservation subsistence activity. In a literal interpretation of these propositions, the existence of insurance markets would vitiate risk rationing as a form of credit constraints. This is a strong condition and needs to be investigated as a specific hypothesis; that is, if participation in insurance reduce the incidence of risk rationing, and if asymmetric information defines quantity or price rationing. Quantity rationing would more likely be tied to asymmetric information, but whether farmers classified as risk rationing have also been rationed or refused debt at some time may be indicative (as a testable hypothesis) of the effects of asymmetric information. The demand for credit is important. The demand elasticity may appear to be perfectly inelastic whether the farmer is risk rationed, quantity rationed or price rationed. More generally, we would expect that the demand elasticity for credit is more inelastic for risk rationed farmers than quantity or price rationed farmers. These relationships between credit demand elasticities and rationing are testable hypotheses.

In the next section, we briefly review the literature on risk rationing. We then describe our approach to segregating credit rationed, price rationed and risk rationed farm households, and the survey and data that used in the analysis. Empirical results are then presented and policy implications discussed.

### *Credit Rationing Status and Credit Constraints*

The survey asked questions that made it possible to infer respondents' credit rationing status based partly on Boucher, Guirkinger and Trivelli (2009) strategy to directly elicit credit constraint. Constraint categories can be defined as follows.

> 1) Price rationed or unconstrained farmer are those who may either borrow or not, and are satisfied with the loan amount at the price offered. External price rationing can occur if the lender raises interest rates and/or transaction costs, so that free choice along the credit demand curve results in a utility maximizing position. Internal price rationing occurs when a borrower chooses or not to borrow at fair market prices and transactions costs. Price rationing in this context is determined by cost-quantity tradeoffs along the demand curve and the degree by which these tradeoffs take place is determined by individual credit demand elasticities which, as we show later, differ amongst borrowers.
>
> 2) Quantity rationed, or supply-side-constrained, farmer may be either an applicant who was rejected a loan or a non-applicant who knew that he would be rejected. A quantity rationed farmer faces a binding credit limit; therefore, the limiting constraint comes from the supply side. A quantity rationed farmer is expected to have excess demand.
>
> 3) Risk rationed farmers do not face a binding limit and therefore does not have excess demand for credit. The limiting constraint comes from the demand side. Their demand is lower because of the risk-sharing rules associated

with the loan contract. Asset wealth, financial wealth, risk aversion, prudence and property rights are all aspects of the risk rationing problem identified in BCG.

### *Survey and Data*

We use direct elicitation methods to gather information on the credit market perceptions of both borrowers and non-borrowers. Figure 1 shows the structure of the survey questions required to segregate and identify credit constraint status for the China survey. An equivalent instrument was modified for Mexico. We divide farmers into two groups. Farmers in the first group do not have to apply for a loan but instead have the lender (bank, buyer or for China, the Rural Credit Cooperative (RCC)) evaluate their creditworthiness and offer them a loan. Farmers in the second group must formally request a loan. In the first group, since a loan offer is made farmers are not quantity rationed. We asked the first group "How much of loan did RCC or Bank offer to lend you?" and "How much of loan did you actually use?" Risk rationed farmers are defined by those who responded that the amount of loan they use is less than the amount offered by the RCC or bank, specifically, because they are afraid of losing collateral. This is distinguished from farmers who use less than the offered loan but not because they fear losing collateral. In keeping with BCG, these respondents are labeled as being price rationed.

In the second group, farmers must request a loan. We asked farmers whether they applied for a loan within the past 2 years. It is a challenge to accurately classify the constraint status of individuals who do not participate in the credit market. They might not have applied for a loan because of three reasons; first, they had enough money and therefore no need to borrow (price rationed); second, they knew that they would be rejected (quantity rationed); or third, they were afraid to lose collateral (risk rationed). On the other hand, among the loan applicants, farmers who applied for a loan but were either rejected or offered an amount less than requested are quantity rationed. Price rationed farmers either accepted the approved loan or applied but did not accept the approved loan because of reasons other than risk associated with a loan contract. Risk rationed farmers did not accept the approved loan because they were afraid of losing collateral. Once identified according to the schematic in figure 4.1, the three rationing typologies are used as dependent variables in the regressions that follow.

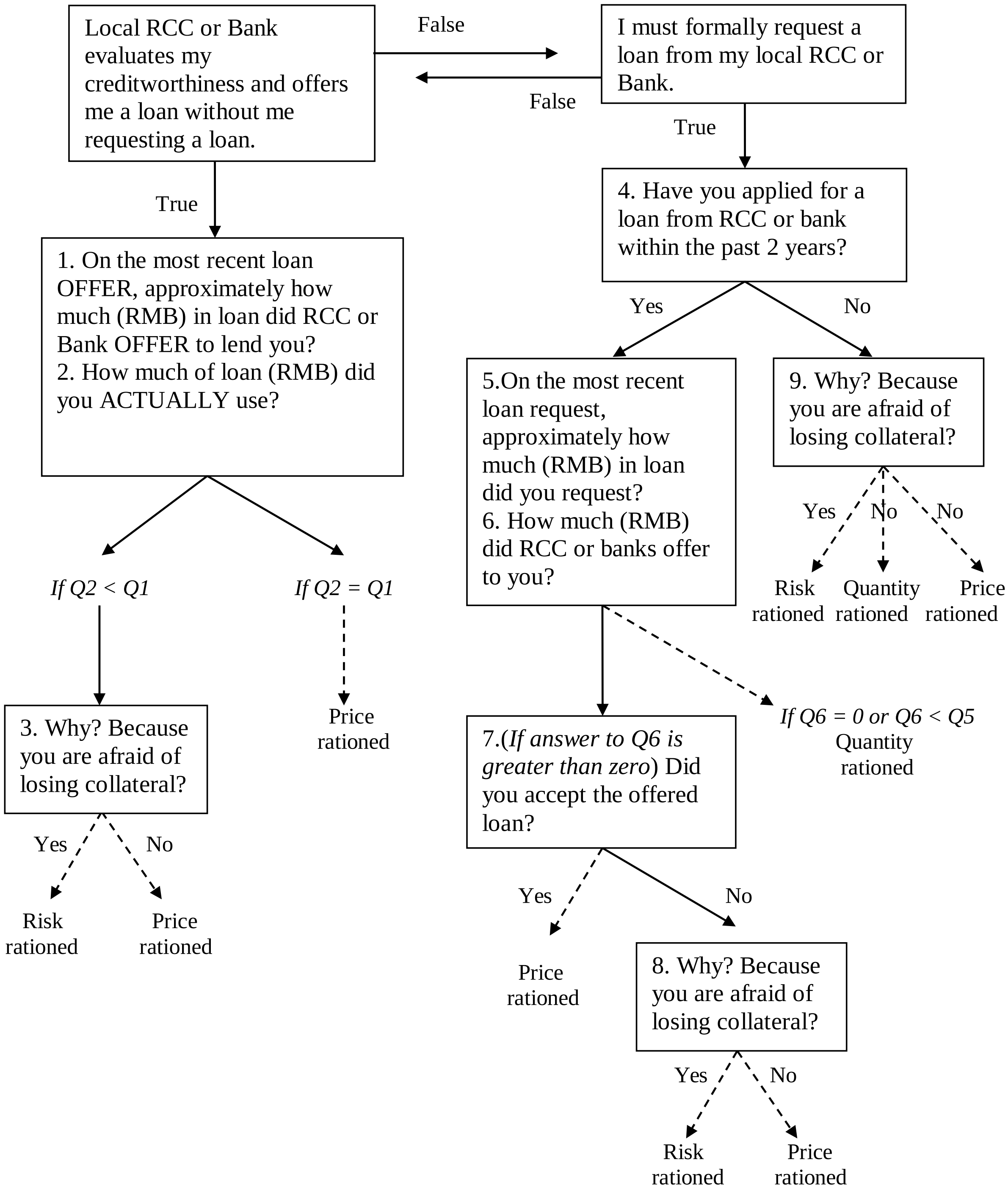


Figure 4.1. Sample survey questions to identify credit constraint status in China. an ad hoc version was used to identify the status of Mexican farmers.

As mentioned before, the farm household survey in China was conducted in the Shaanxi province, Yangling district in November 2010. 730 households were surveyed. Each household was interviewed by graduate students from Northwest Agriculture and Forestry University[7]. The survey in Mexico was conducted in September 2011, through the assistance of a local integrator company. Local college students were hired to interview farmers with principal investigators always present. The characteristics of these communities are as follows. On average there are about 5 people living in each household for both China and Mexico. The average education level of respondents is between attending middle school and completing middle school for Chinese farmers, while for Mexican farmers the average education is attending some elementary school and finishing elementary school. The average number of farming years for China is 28, while for Mexico is 22. From our Chinese data, the average farm size is 5mu (about 5/6th of an acre), however, the average farm size for the Mexican farmers is 10 Hectares (about 24 acres). In the Chinese survey, household average yearly income is 23,796 RMB with approximately 39% of household income coming from farm activities. Similarly for Mexico, our results show an average household income of 64,115 pesos, 61% of them derived from farming activities. The average profit per year earned from cropped land is 953 RMB/mu for China, and 3,702 peso/Ha for Mexico. The average asset per household is 318,904 RMB for China and 532,838 pesos for Mexico. There are 203 Chinese farmers that indicated any amount of debt; the average debt per household is 29,330 RMB. Similarly, 125 Mexican farmers indicated to have any debt. The average debt in Mexico is 25,231 pesos. Tables 4.1 and 4.2 report some descriptive statistics on Chinese and Mexican farmers.

Table 4.1.Descriptive statistics of Chinese farmers.

| Variable | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Sex (Female =1) | 730 | 0.54 | 0.49 | 0 | 1 |
| Age | 730 | 48.72 | 11.36 | 18 | 78 |
| Education | 730 | 4.37 | 1.83 | 0 | 8 |
| Household member | 730 | 4.88 | 1.51 | 2 | 18 |
| Years of Farming | 726 | 27.66 | 13.54 | 0 | 65 |
| Farm Size (mu) | 728 | 4.93 | 2.81 | 0 | 40 |
| Household Income (RMB) | 721 | 23,796 | 23,048 | 0 | 248,000 |
| Percentage farm Income | 720 | 39.29 | 29.32 | 0 | 1 |
| Asset Value (RMB) | 703 | 318,904 | 1,897,610 | 0 | 50,000,000 |
| Farm Profit (RMB/mu) | 710 | 952 | 1,915.054 | 0 | 25,000 |
| Amount of Debt (RMB) | 203 | 29,329 | 58,190 | 0.01 | 600,000 |

Table 4.2.Descriptive statistics of Mexican farmers.

| Variable | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Sex (Female =1) | 372 | 0.13 | 0.34 | 0 | 1 |
| Age | 372 | 52.79 | 13.75 | 18 | 87 |
| Education | 369 | 1.84 | 1.59 | 0 | 8 |
| Household member | 372 | 5.15 | 2.55 | 1 | 17 |
| Years of Farming | 364 | 21.97 | 12.38 | 1 | 68 |
| Farm Size (Ha) | 372 | 10.84 | 5.04 | 0 | 40 |
| Household Income (MXP) | 372 | 64,115 | 56,006 | 6,000 | 450,000 |
| Percentage farm Income (MXP) | 372 | 61.49 | 24.17 | 0 | 1 |
| Asset Value (MXP) | 372 | 532,838 | 566,206 | 12,000 | 7,500,000 |
| Farm Profit (MXP/Ha) | 372 | 3,702 | 3,705 | 0 | 30,000 |
| Amount of Debt (MXP) | 125 | 25,231 | 36,663 | 0 | 300,000 |

1 Ha = 15 Mu

### *Risk Rationing, Quantity Rationing and Price Rationing*

Using the above approach, we obtained the following groupings. The first was a group of 52 farmers in China, and 18 in Mexico, who did not request a loan but a local RCC, bank or buyer evaluated their creditworthiness and offered them a loan. Among farmers who borrowed less than the amount that the lender was willing to provide, 27.3% of Chinese farmers indicated that they did not use the total amount of credit made available to them because they were afraid of losing collateral, but none of the Mexican farmers indicated as a reason for not taking the full loan the fear of losing collateral. In the second group, 672 Chinese and 354 Mexican farmers indicated that they must formally request a loan. Of these, only 121 Chinese and 45 Mexican farmers had applied for a loan within the past two years and no risk rationed farmers were found in this group. Among those who had not applied for a loan, approximately 7.5% of Chinese and 39% of Mexican farmers were determined to be risk rationed because they indicated that the risk of losing collateral was important to their loan choices. Among all 730 Chinese and 372 Mexican respondents, the total proportion of risk rationed farmers is approximately 6.2% for China and 34.67% for Mexico. We determined that approximately 14% of all Chinese respondents and 9.94% of Mexican farmers were quantity rationed. These farmers indicated that they had formally requested a loan from RCC, bank or buyer within the past two years, but the lender either did not offer them any loan or offered less than the amount requested. Also included in the quantity rationed group are farmers who had not applied for a loan because they believed they would be rejected, were deemed not to be credit worthy or were unable to obtain a group or individual guarantee. 79.9% of Chinese and 55.37% of Mexican farmers were deemed to be price rationed. Price rationed farmers indicated either that they actually used a loan offered to them without requesting it; applied for a loan and accepted the offered loan; or are non-borrowers with no need to borrow.

Tables 4.3 and 4.4 provide a summary of household characteristics and frequencies by credit constraint status. The tables compare the means and medians of several key variables for 3 types of credit rationed farmers. Risk rationed farmers tend to be a bit younger and substantially more educated than quantity and price rationed farmers. The household income, asset value and farm profit of quantity rationed farmers are less than that of risk rationed and price rationed farmers. As expected, poor farmers are more likely to be quantity rationed as it is difficult to get a loan approval by RCC, bank or buyer. Among Chinese farmers, the risk rationed group has the highest median household income, asset value and farm profit but the lowest amount of debt. However, for Mexican farmers, the group with the highest median household income, asset value and farm profit is the price rationed, followed by quantity and then risk rationed. The average amount of debt is highest for price rationed, then risk rationed and finally quantity rationed. They all have the same median of zero debt. The Chinese results are in general consistent with the theoretical findings of BCG that risk rationing is not linked to farm households with low asset and financial wealth. For China, the mean and median incomes of risk rationed households are higher than both the quantity and price rationed groups. However, the results for Mexico show that the risk rationed farmers have the lowest household income, asset value and farm profit measured as average and median. In any case, as predicted by BCG, one cannot take for granted the notion that only the poor, collateral constrained households are risk rationed as a matter of course. Behavioral aspects dealing with prudence and risk aversion may come into play.

Table 4.3.Summary of household characteristics and frequencies by credit constraint status for Chinese farmers.

| | Non-price Rationed | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Risk Rationed | | Quantity Rationed | | Price Rationed | | Total | |
| | mean | median | mean | median | mean | median | mean | median |
| Sex (Female =1) | 0.67 | 1.00 | 0.54 | 1.00 | 0.54 | 1.00 | 0.55 | 1.00 |
| Age | 44.87 | 47.00 | 48.70 | 50.00 | 49.02 | 50.00 | 48.72 | 50.00 |
| Education | 4.67 | 5.00 | 4.17 | 5.00 | 4.38 | 5.00 | 4.37 | 5.00 |
| Years of Farming | 25.87 | 27.00 | 29.54 | 30.00 | 27.48 | 30.00 | 27.67 | 30.00 |
| Farm Size (mu) | 5.00 | 5.00 | 5.18 | 5.00 | 4.88 | 5.00 | 4.93 | 5.00 |
| Household Income (RMB) | 26,337 | 22,000 | 21,301 | 16,000 | 24,040 | 20,000 | 23,796 | 20,000 |
| Percentage farm Income | 41 | 30 | 42 | 36 | 39 | 31 | 39 | 32 |
| Asset Value (RMB) | 210,166 | 200,000 | 208,234 | 145,000 | 346,280 | 150,000 | 318,904 | 150,000 |
| Farm Profit (RMB/mu) | 1,296 | 700.00 | 564 | 500 | 994 | 500 | 952 | 500 |
| Amount of Debt (RMB) | 21,500 | 7,500 | 29,009 | 10,000 | 29,837 | 20,000 | 29,329 | 18,000 |
| Observations | 45 | | 102 | | 583 | | 730 | |
| Percentage of sample | 6.2 | | 14 | | 79.9 | | 100 | |

Table 4.4.Summary of household characteristics and frequencies by credit constraint status for Mexican farmers.

| | **Non-price Rationed** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Risk Rationed** | | **Quantity Rationed** | | **Price Rationed** | | **Total** | |
| | **mean** | **median** | **mean** | **median** | **mean** | **median** | **mean** | **median** |
| Sex (Female =1) | 0.124 | 0 | 0.135 | 0 | 0.145 | 0 | 0.137 | 0 |
| Age | 53.83 | 53 | 53.59 | 55 | 52 | 54 | 52.79 | 54 |
| Education | 1.84 | 1 | 1.40 | 1 | 1.92 | 1 | 1.84 | 1 |
| Years of Farming | 21.75 | 22 | 25.37 | 25 | 21.52 | 22 | 21.97 | 23 |
| Farm Size (Ha) | 10.49 | 10 | 10.91 | 10 | 11.05 | 10 | 10.85 | 10 |
| Household Income (MXP) | 54,574 | 40,000 | 55,059 | 47,000 | 71,716 | 49,200 | 64,115 | 45,750 |
| Percentage farm Income | 58 | 62 | 62 | 63 | 63 | 66 | 61 | 64 |
| Asset Value (MXP) | 430,620 | 350,000 | 524,594 | 400,000 | 598,330 | 450,000 | 532,838 | 400,000 |
| Farm Profit (MXP/Ha) | 3,144 | 2,200 | 3,403 | 2,500 | 4,163 | 2,763 | 3,702 | 2,500 |
| Amount of Debt (MXP) | 7,052 | 0 | 5,621 | 0 | 9,902 | 0 | 8,488 | 0 |
| Observations | 129 | | 37 | | 206 | | 372 | |
| Percentage of sample | 34.67 | | 9.94 | | 55.37 | | 100 | |

### *The Model and Determinants of Credit Constraint Status*

To investigate the various hypotheses jointly, we run a series of regressions to segregate cause and effect. Because our interest is in risk rationing relative to quantity and price rationing our regressions include four categorizations as Boolean (1,0) dependent variables; that is the risk rationed group relative to all others, the quantity rationed group relative to all others and the price rationed group relative to all others. The analysis applies both the linear probability model and the logit model using a robust estimator to test the hypotheses.

*Credit Demand*

An interesting feature of our study is our use of credit demand elasticities. In Turvey et al. (2011) it was shown that elasticities were highly heterogeneous across borrowers with some having high elasticities and others perfectly inelastic demands for (formal) credit; that elasticities were endogenously determined by many demographic and economic factors and thus were far more complex than what has previously been discussed; and that credit demand is more inelastic at higher interest rates and less inelastic or elastic at lower interest rates. The importance to the current study is that assuming homogenous preferences for farm credit is a weak and perhaps erroneous assumption. To counter this we imbedded within our China and Mexico survey a polychotomous choice build to derive the 'relative' credit demand elasticities of respondents. The build included two mutually exclusive choice frameworks. For Chinese farmers, we used a 7% interest rate as a benchmark. We first asked farmers to rank on a five-point Likert-type scale their demand response (from Definitely Borrow a lot more to Definitely not borrow anymore) when interest rate decreased from 7% to 6%, 5%, 4%, and 3% (called lower interest rate) and then using a reverse scale their response when interest rates increased from 7% to 8%, 9%, 10%, and 11% (called higher interest rate), assuming that respondents can borrow as much as they need. Similarly, for the Mexico survey the interest rates were benchmarked to the market rate of 35%. The low interest rates were 5%, 15%, 25% and 35%; while the higher interest rates were 35%, 45%, 55% 70% and 90%. Using the responses from this credit demand scale, we created 10 binary variables to indicate characteristics of each respondent as to whether his credit demand was perfectly inelastic; highly inelastic, medium elastic, moderate elastic and highly elastic for lower and higher interest rates. As will be discussed, the results from the credit demand elasticity build shows that demand preferences do indeed differ by rationing group with a surprising and interesting find that the risk rationed group has a nearly perfectly inelastic demand for credit at high interest rates but a positive demand for credit at lower interest rates. This results suggests that risk rationing is not entirely independent of interest rates, and that even otherwise risk rationed farmers might consider borrowing if interest rates are low enough.

*Informal Lending*

In addition to formal credit, our previous research (Turvey, Kong and Huo 2010; Turvey and Kong 2010) has shown that informal credit between friends and relatives (familial lending) is an important economic consideration in China. While many farmers in our surveys use familial lending, some borrow exclusively from informal sources while others may combine informal borrowing with formal borrowing. We include binary variables for whether the respondent held informal credit (friends and family); and/or formal credit to capture effects between formal and informal credit.

*Land use Rights*

As discussed previously, part of the motivation for the present study resulted from a query in 2009 relating to the use of land use rights as collateral. We repeated the question in the current study to see whether there was greater incidence of a negative response for risk rationed farmers. Willingness to borrow if they could use land use rights as collateral was measured on a five-point scale (from definitely borrow more to not borrow any more). The higher the value, the less likely farmers will borrow. All Mexican farmers in our survey hold property rights, so there was no need to include this query in the Mexico survey.

*Entrepreneurship*

We include a dummy variable to account for farmers' entrepreneurial activity. The variable "Ever started business" takes a value 1 if respondents have ever started a new business and 0 otherwise. Whereas, the variable "Plan to start business" takes value 1 if respondents are planning to start a new business and 0 otherwise. Questions on entrepreneurship were not asked of Mexican farmers.

*Measures of Wealth*

In the literature, both financial wealth and productive wealth are significantly associated with credit rationing. Specific variables include farm size, household income, percentage of farm income, asset value and saving. Farm size is a proxy of productive wealth and the rest are proxies of financial wealth.

*Measuring Risk Aversion and Prudence*

We asked a series of questions about risk taking, risk mitigating and precautionary saving behavior that would reflect such attributes and used these to compute a risk aversion score and prudence score. The risk aversion score is based on farmers' willingness to take risk, risk management options use and perceptions. In the survey, farmers were asked to identify their willingness to accept greater production risks in order to increase the chance of higher profits, to take risks with new technologies, and to take risks with new management practices before seeing good results in other farms. In addition, farmers indicated the importance of risk management on their farm. Risk management options included farm diversification, geographic diversification, irrigation, marketing diversification, forward contracts, participation in government programs, maintaining financial reserves and investing off-farm for other sources of income.

The prudence score was calculated based on the purposes of their precautionary savings. Farmers specified their level of agreement or disagreement on a five-level Likert scale for a series of statements; 'I save in case my automobile break down'; 'I save for unexpected medical emergency'; 'I save to protect job loss'; and 'I save for unanticipated crop loss'. The higher the score would indicate that the respondent is more prudent.[8]

*Insurance Markets*

Measure of insurance market participation is represented by insurance variable. Farmers indicated whether they regularly purchase insurance for any of the following items: life insurance, fire insurance for home and, automobile insurance, health/medical insurance, farmer's minimum living standard security, rural old-age insurance, crop insurance, and livestock insurance. The higher value of insurance variable would imply the more participation in insurance markets.

*Asymmetric Information*

Rural Credit Cooperatives and other agricultural lenders will often evaluate individual borrowers, and sometimes entire villages, offering certificates of credit worth. Creditworthiness is based on individual interviews as well as the word of village leaders. In China for instance, a village will form a village credit committee which will include the village leader, members of the community and RCC personnel. In addition lenders may require a group guarantee with 3 or 4 friends or relatives agreeing to secure a loan. The borrowers and the guarantors are then vetted by front-line lenders and managers. Collectively the purpose of the activities and declarations is to eliminate asymmetric information. A farmer deemed credit worthy or with a guarantee removes informational asymmetries and in principle would be more likely to receive a loan. To capture asymmetric information, we include two binary variables; credit worthy and group guarantee variables. In the presence of asymmetric information, creditworthy borrowers may be denied credit because they are unable to meet such collateral requirements or pay such high interest rates. Loan may be refused or diminished if borrowers are not members of group guarantee in which every member of a group ensure the repayment of all members. The credit worthy variable takes a 1 if a respondent indicated he is currently considered a 'Credit Worthy' borrower by a local RCC or buyer, or 0 otherwise. The group guarantee variable takes value 1 if a respondent indicated he is a member of a Group Guarantee, or 0 otherwise. Predetermination of credit worthiness and group guarantees is an institutional structure that is unique to China and therefore related questions are not included in the Mexican survey.

### *Empirical Results*

In this section we report results of the hypotheses testing. Tables 4.5, 4.6 and 4.7 present the results from linear probability model. The theory suggests that there will be a negative relationship between quantity rationing and wealth. We find that this holds true for China, but the result is not significant for Mexico. In China, both models show a negative and significant relationship between quantity rationed farmers and asset value. In addition, both China and Mexico show asset value to be significant and positively associated with price rationing. As expected, relatively financial poor are more likely to be quantity rationed because from a lenders' perspective, the likelihood of repayment of the poor may be small. However, this does not appear to be the case for productive wealth, which has an insignificant coefficient for the farm size variable on both quantity and risk rationing. We also tested the hypothesis that the financial wealthy are risk rationed and this does not hold true in both models in the two countries. Our results are not consistent with what Thiele and Wambach (1999); and BCG found, that it is the financially wealthy who will be risk rationed.

We find risk aversion and prudence to be positively correlated with risk rationing and quantity rationing in China. In the case of Mexico, risk aversion is positively significant for risk rationed but negative for prudence. Risk aversion is negatively significant for price rationed in Mexico but not significant for China. In China, relatively high risk averse and prudent farmers tend to be risk rationed. The coefficient on interaction term between risk aversion and prudence is negative and significant indicating that risk aversion and prudence work in an opposite direction for risk rationed farmers. This is consistent with a key result in BCG that prudence and risk aversion can have opposing effects, and Boucher, Guirkinger and Trivelli (2009) that risk rationing should be more likely among households that are more risk averse. For quantity rationed Chinese farmers, the effect of risk aversion and prudence are negative while the coefficient on the interaction term between risk aversion and prudence is positive and significant, showing that the relationship between risk aversion and prudence for quantity rationed farmers are complementary. This is not the case for Mexico, where only the prudence score is marginally significant but positive. In China, neither risk aversion nor prudence, or their interactions are significant for price rationed farmers; although Mexican price rationed farmers show a negative significant value in risk aversion. Implicit in BCG's model is that prudence and risk aversion directly affect, or interact to affect, loan choices and loan rationing typologies. This important observation is upheld by our results.

Our results for China shows that the likelihood of being risk rationed increases significantly with participation in insurance markets as presented in both the linear probability and logit models. The results for Mexico are not significant. Risk adverse households who tend to have a higher willingness to pay for insurance and to participate in insurance markets are more likely to be risk rationed. This is not consistent with the risk rationing characterization given by BCG's definition of risk rationing as stated at the beginning of this paper. Rather, these results suggest that while absence of insurance may be a sufficient condition (which is not easily tested), but may not be a necessary condition. In other words, risk rationing can exist in the presence of insurance markets. In contrast, the likelihood of being quantity rationed in China significantly decreases with the increase in insurance markets participation, perhaps because lenders view insurance favorably as they would any other guarantee. Again, this result is not significant for Mexico.

We examine the effects of asymmetric information on the three rationed types. This was only tested for China, since group guarantee are nonexistent in our Mexico sample. Being considered as a credit worthy borrower and being a member of group guarantee appear to have no impact on risk rationing. This a sensible result because risk rationing is not tied to credit worthiness but a more intrinsic, cognitive, attitude towards credit risk by the borrower. However, credit worthiness is significantly decreasing with quantity rationing as anticipated. Creditworthiness has to do with the ability of a borrower to pay current debt in a timely manner. Lenders would be more willing to provide loans to credit worthy individuals. The coefficients of credit worthiness and group guarantee are significant and positive on price rationed farmers. This could simply be that farmers who are credit worthy or are member of group guarantee are more likely to be price rationed, which simply means that they can borrow along their credit demand curves without restriction. Returning to BCG's definition of risk rationing, it is implied that asymmetric information is an important consideration and this in fact holds for the exact group to which asymmetric information could lead to credit constraints. Our empirical results suggest that asymmetric information is neither necessary nor sufficient to define the risk rationed group because by definition the risk rationed do not participate in the credit market.

Table 4.5.Linear probability model for risk rationed producers.

| | Risk Rationed | | | |
|---|---|---|---|---|
| | **China** | **p-value** | **Mexico** | **p-value** |
| Sex (Female =1) | 0.0390119* | 0.061 | -.1064668 | 0.176 |
| Education | 0.0074557 | 0.212 | .0164944 | 0.352 |
| Years of Farming | 0.0002039 | 0.804 | -.0002508 | 0.917 |
| Farm Size | -0.0010763 | 0.743 | .0033023 | 0.569 |
| Household Income | -8.31E-08 | 0.781 | -1.95E-06 | 0.218 |
| Percent Farm Income | 0.0374555 | 0.354 | -.0909334 | 0.428 |
| Asset Value | -1.16E-09 | 0.274 | -9.64E-08 *** | 0.067 |
| Saving | 0.0015636 | 0.884 | 1.90E-06 | 0.570 |
| Informal Borrowing | -0.0129207 | 0.54 | 0.1687906 | 0.202 |
| Formal Borrowing | -0.0638383*** | 0.003 | -0.1315146 ** | 0.032 |
| Insurance | 0.0269298* | 0.062 | 0.0283218 | 0.631 |
| Highly Inelastic_lower_i | -0.0243217 | 0.356 | 0.0282084 | 0.722 |
| Medium Elastic_lower_i | 0.0182933 | 0.632 | -.0383204 | 0.671 |
| Moderate Elastic_lower_i | -0.0173542 | 0.722 | 0.0615445 | 0.657 |
| Highly Elastic_lower_i | 0.1625621 | 0.164 | 0.0965279 | 0.676 |
| Highly Inelastic_higher_i | -0.0303448 | 0.366 | -0.057318 | 0.673 |
| Medium Elastic_higher_i | -0.0124085 | 0.778 | -0.077946 | 0.790 |
| Moderate Elastic_higher_i | -0.047337 | 0.271 | -0.496064 | 0.120 |
| Highly Elastic_higher_i | -0.0604622 | 0.512 | | |
| Land Use Rights as Collateral | 0.0014965 | 0.854 | | |
| Credit Worthy | -0.0035254 | 0.875 | | |
| Group Guarantee | -0.030602 | 0.297 | | |
| Ever started business | -0.023436 | 0.244 | | |
| Plan to start business | 0.0113026 | 0.612 | | |
| Risk Aversion Score | 0.0039919*** | 0.01 | 0.130845 | 0.156 |
| Prudence Score | 0.004964** | 0.029 | -.046799 | 0.751 |
| Risk Aversion* Prudence | -0.0000621* | 0.086 | 0.01119 | 0.788 |
| Constant | -0.322263** | 0.012 | .071170 | 0.827 |
| Observations | 575 | | 349 | |

Note: The dependent variable for each column is listed in the column heading.
Farm Size in China is in mu, in Mexico is in Hectares.
Household Income and Asset Value are in RMB for China, and in MXP for Mexico.

***Significant at the 1 percent level, ** 5 percent level, *10 percent level

Table 4.6.Linear probability model for quantity rationed producers.

| | Quantity Rationed | | | |
|---|---|---|---|---|
| | **China** | **p-value** | **Mexico** | **p-value** |
| Sex (Female =1) | 0.0177828 | 0.528 | 0.036534 | 0.452 |
| Education | -0.0040498 | 0.637 | -0.01527 | 0.163 |
| Years of Farming | 0.0014853 | 0.191 | 0.002051 | 0.170 |
| Farm Size | 0.0029848 | 0.594 | -0.00196 | 0.583 |
| Household Income | 4.98E-07 | 0.573 | -1.73E-07 | 0.859 |
| Percent Farm Income | -0.0249433 | 0.652 | -0.00338 | 0.962 |
| Asset Value | -3.92E-09* | 0.093 | -3.17E-09 | 0.922 |
| Saving | -0.0235085 | 0.152 | -3.39E-07 | 0.869 |
| Informal Borrowing | 0.1373711*** | 0.0 | 0.117697 | 0.150 |
| Formal Borrowing | -0.0220723 | 0.635 | 0.024573 | 0.514 |
| Insurance | -0.0292646* | 0.057 | 0.001911 | 0.958 |
| Highly Inelastic_lower_i | -0.0164642 | 0.627 | -0.00455 | 0.926 |
| Medium Elastic_lower_i | 0.0300997 | 0.47 | 0.003874 | 0.944 |
| Moderate Elastic_lower_i | 0.0582786 | 0.426 | -0.02486 | 0.771 |
| Highly Elastic_lower_i | 0.2178793 | 0.123 | -0.07823 | 0.583 |
| Highly Inelastic_higher_i | 0.0115993 | 0.814 | 0.015256 | 0.856 |
| Medium Elastic_higher_i | 0.1249938 | 0.112 | -0.04597 | 0.800 |
| Moderate Elastic_higher_i | -0.0814908 | 0.477 | -0.01447 | 0.941 |
| Highly Elastic_higher_i | -0.3241685** | 0.013 | | |
| Land Use Rights as Collateral | -0.0180144 | 0.117 | | |
| Credit Worthy | -0.1011384** | 0.014 | | |
| Group Guarantee | -0.0658012 | 0.167 | | |
| Ever started business | 0.0007093 | 0.982 | | |
| Plan to start business | 0.0528498 | 0.125 | | |
| Risk Aversion Score | -0.0048225* | 0.094 | -0.05488 | 0.335 |
| Prudence Score | -0.0080622*** | 0.008 | -0.0148 | 0.871 |
| Risk Aversion* Prudence | 0.0001273** | 0.017 | 0.011447 | 0.657 |
| Constant | 0.5936249*** | 0.002 | 0.230025 | 0.253 |
| Observations | 575 | | 349 | |

Note: The dependent variable for each column is listed in the column heading.
Farm Size in China is in mu, in Mexico is in Hectares.
Household Income and Asset Value are in RMB for China, and in MXP for Mexico.

***Significant at the 1 percent level, ** 5 percent level, *10 percent level

Table 4.7.Linear probability model for price rationed producers.

| | Price Rationed | | | |
|---|---|---|---|---|
| | **China** | **p-value** | **Mexico** | **p-value** |
| Sex (Female =1) | -0.0567947* | 0.097 | 0.012191 | 0.882 |
| Education | -0.0034059 | 0.739 | -0.0157 | 0.397 |
| Years of Farming | -0.0016892 | 0.224 | -0.00268 | 0.289 |
| Farm Size | -0.0019085 | 0.764 | -0.00088 | 0.885 |
| Household Income | -4.15E-07 | 0.649 | 1.56E-06 | 0.344 |
| Percent Farm Income | -0.0125123 | 0.848 | 0.105083 | 0.381 |
| Asset Value | 0.00000000508* | 0.079 | 1.14E-07 | 0.390 |
| Saving | 0.0219448 | 0.253 | -2.69E-06 | 0.442 |
| Informal Borrowing | -0.1244504*** | 0.003 | -0.23679 | 0.087 |
| Formal Borrowing | 0.0859106* | 0.088 | 0.11516 | 0.072 |
| Insurance | 0.0023348 | 0.908 | 0.003893 | 0.950 |
| Highly Inelastic_lower_i | 0.0407859 | 0.329 | 0.037414 | 0.652 |
| Medium Elastic_lower_i | -0.048393 | 0.365 | 0.123562 | 0.190 |
| Moderate Elastic_lower_i | -0.0409244 | 0.634 | 0.026673 | 0.854 |
| Highly Elastic_lower_i | -0.3804414*** | 0.01 | -0.03036 | 0.900 |
| Highly Inelastic_higher_i | 0.0187455 | 0.74 | 0.093325 | 0.512 |
| Medium Elastic_higher_i | -0.1125852 | 0.189 | 0.151329 | 0.622 |
| Moderate Elastic_higher_i | 0.1288278 | 0.325 | 0.602629 | 0.071 |
| Highly Elastic_higher_i | 0.3846307** | 0.017 | | |
| Land Use Rights as Collateral | 0.0165179 | 0.224 | | |
| Credit Worthy | 0.1046638** | 0.021 | | |
| Group Guarantee | 0.0964032* | 0.075 | | |
| Ever started business | 0.0227267 | 0.527 | | |
| Plan to start business | -0.0641524 | 0.105 | | |
| Risk Aversion Score | 0.0008307 | 0.793 | 0.018279 | 0.850 |
| Prudence Score | 0.0030982 | 0.406 | 0.07743 | 0.615 |
| Risk Aversion* Prudence | -0.0000652 | 0.303 | -0.02928 | 0.502 |
| Constant | 0.7286381*** | 0.002 | 0.2805 | 0.411 |
| Observations | 575 | | 349 | |

Note: The dependent variable for each column is listed in the column heading.
Farm Size in China is in mu, in Mexico is in Hectares.
Household Income and Asset Value are in RMB for China, and in MXP for Mexico.

***Significant at the 1 percent level, ** 5 percent level, *10 percent level

From our credit demand build in the survey we are able to identify among borrowers who have between highly inelastic and highly elastic demands for credit. These categories are introduced using dummy variables. In the model, none of the elasticity measures are statistically significantly different from 0 for the risk rationed group. In other words, we cannot distinguish risk rationed farmers by their sensitivity to changes in the interest rate. This seems to be consistent with the hypothesis since interest rate variation should not affect the credit demand of risk rationed individuals. This does not mean that risk rationed individuals have perfectly inelastic demands for credit. Quite the opposite is true, that indeed they may have a positive demand for credit but do not act upon this demand. This is critically important to the BCG argument because one of the requirements is that the risk rationed actually have a demand for credit but do not act upon it. Our results empirically validate this important conjecture.

In comparison, the model shows at least some of the elasticity measures being statistically different from zero for the quantity and price rationed typologies. Our results show that quantity rationed individuals are less sensitive to high interest rate than others. But price rationed individuals are more sensitive to high interest rate and less sensitive to low interest rate. This illustrates the excess demand for credit of quantity rationed farmers as interest rate increases or decreases relative to price rationed farmers. To add clarity to these results, tables 4.8 through 4.11 provide cross-tabulations between the inelasticity of credit demand and borrower type. They confirm that risk rationed farmers are more sensitive to lower interest rates. Higher inelasticity indicates a lower willingness to borrow when interest rates vary. At any given interest rate, a large proportion of risk rationed farmers actually have highly inelastic demands as expected. However, when interest rates are low enough, some risk rationed farmers have more elastic demand and despite being non borrowers, could actually enter the credit market. BCG make no claim that risk rationing is a permanent state and these results suggest that as financial risks fall with lower interest rates, risk rationed farmers may in fact enter (or reenter) the credit market.

There appears to be a strongly negative relationship between formal borrowing and risk rationing which is simply a definitional result that having formal debt is inversely related to any likelihood that a respondent would be risk rationed. However, the model does not show that informal borrowing is more prevalent in the risk rationed typology than those in other borrowings. For the quantity rationed typology, we find a positive and significant relationship for informal borrowing in China (p=0.00) and Mexico (p= 0.102). These results show that quantity rationed compensate for unsatiated demand in the formal sector. This does not appear to be the case for the price rationed typology, which has a negative and significant coefficient for the informal borrowing variable indicating a lower demand for informal credit with satiated demand in the formal sector (China p=0.003, Mexico p=0.084). Although BCG do not consider informal borrowing the results reported here are consistent with their principle conjectures.

To capture the willingness to borrow when farmers can use their land as collateral, we find the coefficients on the land use rights as collateral variable for the risk rationing and price rationing typologies are not different from zero. However, the variable is significant and negatively associated with the quantity rationed typology.

We would have expected a stronger negative relationship between using land use rights for collateral for the risk rationed typology. This interesting result is open to interpretation but it suggests that the quantity rationed group may be so rationed because they have a general reluctance to use collateral. The insignificance of the risk rationed group could simply be a statement that reluctance to use land use rights is not a differentiating factor across typologies.

Table 4.8.Measure of inelasticity at lower interest rates for Chinese farmers by borrower type.

| | Borrower Type | | | |
|---|---|---|---|---|
| | Risk Rationed | Quantity Rationed | Price Rationed | Total |
| Highly Elastic | 4.40% | 4.90% | 2.10% | 2.70% |
| Moderate Elastic | 4.40% | 18.60% | 8.30% | 9.50% |
| Medium Elastic | 33.30% | 29.40% | 23.60% | 25.00% |
| Highly Inelastic | 17.80% | 19.60% | 28.60% | 26.70% |
| Perfectly Inelastic | 40.00% | 27.50% | 37.40% | 36.20% |
| Total | 100.00% | 100.00% | 100.00% | 100.00% |

Table 4.9.Measure of inelasticity at lower interest rates for Mexican farmers by borrower type.

| | Borrower Type | | | |
|---|---|---|---|---|
| | Risk Rationed | Quantity Rationed | Price Rationed | Total |
| Highly Elastic | 3.91% | 2.70% | 5.94% | 4.90% |
| Moderate Elastic | 7.81% | 16.22% | 14.36% | 12.26% |
| Medium Elastic | 67.19% | 48.65% | 52.97% | 57.49% |
| Highly Inelastic | 21.09% | 32.43% | 26.73% | 25.34% |
| Perfectly Inelastic | 0% | 0% | 0% | 0% |
| Total | 100.00% | 100.00% | 100.00% | 100.00% |

Table 4.10.Measure of inelasticity at higher interest rates for Chinese farmers by borrower type.

| | Borrower Type | | | |
|---|---|---|---|---|
| | **Risk Rationed** | **Quantity Rationed** | **Price Rationed** | **Total** |
| Highly Elastic | | 1.00% | 0.50% | 0.60% |
| Moderate Elastic | | 1.00% | 1.60% | 1.40% |
| Medium Elastic | 6.70% | 16.70% | 5.90% | 7.50% |
| Highly Inelastic | 8.90% | 20.60% | 15.80% | 16.10% |
| Perfectly Inelastic | 84.40% | 60.80% | 76.20% | 74.50% |
| Total | 100.00% | 100.00% | 100.00% | 100.00% |

Table 4.11.Measure of inelasticity at higher interest rates for Mexican farmers by borrower type.

| | Borrower Type | | | |
|---|---|---|---|---|
| | **Risk Rationed** | **Quantity Rationed** | **Price Rationed** | **Total** |
| Highly Elastic | 0% | 0% | 0% | 0% |
| Moderate Elastic | 0% | 0% | 1.98% | 1.09% |
| Medium Elastic | 0.78% | 0% | 2.48% | 1.63% |
| Highly Inelastic | 7.03% | 8.11% | 7.43% | 7.36% |
| Perfectly Inelastic | 92.19% | 91.89% | 88.12% | 89.92% |
| Total | 100.00% | 100.00% | 100.00% | 100.00% |

In addition, in China females are more likely to be risk rationed but males are more likely to be price rationed. In Mexico, gender has no effect. This is consistent with most studies indicating that women are found to be more risk averse than men. But we should be very careful here because the instrument was indexed to the respondent and not the sex of the decision maker. So this variable might best be interpreted as a control or fixed effect variable. Finally, there is no strong relationship between entrepreneurship variables and all 3 credit rationed types in the linear probability model; however, in the logit model, the coefficient on plan to start business variable is negative and significant on price rationed farmers. Farmers who plan to start business are not likely to be price rationed.

### *Conclusion*

The purpose of this paper was to analyze the characteristics for risk rationing and to provide a specific test of the risk rationing theory proposed by BCG. Among all respondents, 730 in China and 372 in Mexico, the total proportion of risk rationed, quantity rationed and price rationed farmers are approximately 6.2%, 14% and 79.9% respectively for China and 34.67%, 9.94% and 55.37% respectively for Mexico. The results verify the existence of risk rationing in both China and Mexico rural credit markets. There is a strong support to the theory that the financial poor are more likely to be quantity rationed but the financial wealthy are more likely to be risk rationed. However, the productive wealth appears to have to no impact on all types of credit constraint typologies. We find that risk averse and prudent individuals are more likely to be risk rationed. This is likely due to innate risk judgments made by individuals. Our study is among the first that we are aware that has been able to provide evidence that in fact risk rationing behavior can take place in the presence of insurance markets. This evidence is not consistent with BCG, which stated that risk rationing occurs when insurance markets are absent. Combining the results, risk adverse households tend to have a higher willingness to pay for insurance and participate in insurance markets and are more likely to be risk rationed.

The elasticity of demand for credit has a strong implication for credit markets and we find that credit demand elasticities differ amongst rationing typologies. We find that a large proportion of risk rationed farmers have perfectly inelastic demand for credit but at lower interest rates even risk rationed farmers might enter the credit market.

What we have learned from studying risk rationing is that efforts to enhance the working of rural credit markets and credit access in order to increase agricultural investment and alleviate poverty must also deal with risk**.** BCG argue that failure to account for risk rationed agents, who have profitable projects but are discouraged from implementing them because of the riskiness of the available loan contracts, may lead to a distortion of the rural financial system. We agree. One policy remedy is to maintain lower interest rates since we find that risk rationed groups may enter the credit market. Such a policy is not without its critics however. In addition, BCG considers at length the role of ambiguous property rights. This is the current state of land use in China. The current debate in China regarding transferability and mortgagability of land use rights might be successful if collateral played a key role in borrowing agreements[9]. However, land use right reform in China will be only partially effective to encourage risk rationed borrowers to enter the credit market since our results do not indicate that using land use rights for collateral can differentiate risk rationed farmers from other typologies. As a result, policies that decrease the risk associated with loan contract to rural households would be more appropriate in the presence of risk rationing.

## *Endnotes*

[1] Both papers report survey results from Peru with the first reporting surveys in 1997 and a second sample in 2003/2004. It is not clear if this is the same data in both papers but the range of risk rationing is nonetheless in the same range of 21% to 25% as indicated.

[2] BCG also includes transactions cost rationing. We set this aside from an empirical point of view by assuming that transactions costs imposed by a lender to increase the cost of borrowing or endogenous to the borrower through travel costs or inconvenience and so on are incorporated into the price rationing component.

[3] Using survey data from Peru to measure the incidence and impact of credit constraints in the formal credit sector Boucher, Guirkinger, and Trivelli (2009), provide examples of responses associated with risk rationing. Of these, the most common response in each of the surveys they conducted was "I don't want to risk my land".

[4]We collaborated with Interagro de las Huastecas, S.A. de C.V., a local producer integrator, which provided logistic support and sampling design.

[5]The idea of the third derivative of the utility function as a way to represent preferences for precautionary savings was first mentioned by Leland (1968). If the third derivative is positive, the consumer has a preference for precautionary savings. Analogous to the Arrow-Pratt index of risk aversion, Kimball (1990) coined the index of absolute prudence, which represents the strength of precautionary savings as $-\frac{u'''(x)}{u''(x)}$.

[6] The majority of these loans were for non-agricultural uses.

[7] The survey investigated areas other than risk rationing including farm credit, risk perception and management, transaction of land use rights, and entrepreneurship. Only the risk rationing component is discussed here.

[8] We also conducted a simple field experiment to estimate the partial risk aversion coefficient of the farmers based on Binswanger (1981) which is used as a proxy of risk aversion.

[9] Stiglitz and Weiss (1992) argued that collateral and other non-price rationing devices would not eliminate the possibility of credit rationing.

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CHAPTER 5

# RISK RATIONING AND JUMP UTILITY

***Abstract***

This chapter investigates the concept of risk rationing in a jump utility framework. The current definition of risk rationing, that individuals refrain from borrowing for fear of losing collateral, is based on a principal-agent model that excludes exogenous risk factors. Production is based on different effort levels. The model proposed in this chapter depends on the first three moments of the expected return distribution. The theoretical model is developed and tested empirically on Mexican farmers using data from a survey conducted in 2011. Our results suggest that risk rationing can be modeled as having a jump disutility. Preference for risk rationing depends on the difference in the expected return distribution moments of the two states (debt and no debt). My results suggest that risk rationed have a stronger preference for skewness than borrowers (price rationed), but not necessarily for the first two moments. Also, the utility at their initial level of wealth is higher for risk rationed, suggesting that their discount rate is larger than price rationed. These results provide elements for policies to integrate risk rationed into the formal credit market.

### *Introduction*

In recent years a renewed policy interest in rural credit for generally poor and underrepresented farmers has given rise to a more concentrated interest in factors affecting credit demand. An offshoot to this effort has culminated in the refinement of credit rationing to include not only the notion of price and quantity rationing but also risk rationing (Boucher, Carter and Guirkinger, 2008). Risk rationing describes an individual that having the asset wealth to qualify for a credit, voluntarily refrains from it for fear of losing his collateral. Unlike borrowers, risk rationing individuals believe that by taking a loan, a positive and sufficiently large probability of default may occur.

Under imperfect markets, which are mostly the case in the agricultural sector in developing economies, production risk cannot easily be diversified away and thus it is not independent of consumption. Under imperfect markets, or where "capital markets are inefficient" Masson (1974) argues that jump disutility and its corresponding avoidance behavior is more likely to occur. The existence of a jump disutility can affect risk taking behavior in a way that appears to mimic risk rationing behavior. This is what is explored in this paper. According to Masson, under disaster avoidance a risk-averse investor may choose an investment as its variance increases, as long as its lower bound is above a threshold level. Even though this behavior can be found in the absence of disutility jumps, the presence of these can induce this paradoxical behavior. This action relates to Roy's (1952) safety first criterion. Robinson and Lev (1986), referring to Masson's model, provide an example of a firm facing liquidation costs as the source of a disutility jump: An investor may refrain from borrowing, even if he wants to borrow at the market interest rate, if the disutility caused by liquidating assets in case of default is sufficiently large. This approach relaxes some of the more restrictive assumptions in Boucher et al. (2008) (e.g. effort differentiation and insurance markets) but also confirms some of the more critical aspects dealing with asset wealth, risk aversion and prudence.

In our view, it is the exogenously determined probability of default, along with asset values (principally land), that creates a state of disutility to be avoided as first analyzed by Roy in his Safety First model. Moreover, in the economic development context, some implications of a jump disutility, without using this term, have also been described albeit briefly. An important implication is that jump disutilities may be indicative of poverty traps (Lybbert and Barrett, 2011) which may provide a deeper understanding of the ubiquitous nature of poverty traps as investigated in Barrett et al. (2006), Hoddinott (2006), McPeak (2004), and Zimmerman and Carter (2003) among others. Another characteristic of risk rationing is the inter-temporal rate of substitution and a consequentially higher discount factor on future consumption as discussed in Pender (1996). Pender (1996) uses the ratio of marginal indirect utilities of initial wealth and future wealth to measure the discount factor. Alternatively, we can look at the utility of initial wealth for two identical individuals that have the same expected returns; those with higher utility at initial wealth would prefer current consumption more. This too is a characteristic of risk rationed individuals with jump utility who are expected to have a higher initial marginal utility, reflecting in part their time preference for consumption.

The purpose of this paper is to investigate risk rationing in a jump utility framework. We develop the relationship in a theoretical context and then investigate the extent of risk rationing amongst Mexican farmers. The elementary claim is that if a farmer's loss due to asset liquidation is sufficiently large, he may exhibit a jump discontinuity at a critical income level. Falling below this level could force liquidation of critical assets in order to meet financial obligations. Masson (1974) provides evidence of a utility function with a discontinuity in the form of a vertical jump, representing a large loss in utility due to income falling below a critical level. He makes analogies that the threshold is some situation that will lead to an undesirable state of nature and thus cause a large disutility, like a divorce or being declared bankrupt. In this model, farmers get utility from both income (or any variable of interest), and the state of nature. The different states are defined by being above or below a threshold level. Our results suggest that risk rationing can be modeled as having a jump disutility. Preference for risk rationing depends on the difference in the expected return distribution moments of the two states (debt and no debt). Our results suggest that risk rationed have a stronger preference for skewness than borrowers (price rationed), but not necessarily for the first two moments. Also, the utility at their initial level of wealth is higher for risk rationed, suggesting that their discount rate is larger than price rationed. Our results provide elements for policies to integrate risk rationed into the formal credit market.

### *Risk Rationing*

The concept of risk rationing has been observed by many but not formally analyzed. An early sentiment of risk rationing is by Binswanger and Siller (1983) who state that "If the disutility of the loan is sufficiently high, small farmers may stop borrowing altogether, i.e. the credit market for small farmers may disappear because of lack of demand, despite the fact that small farmers may still have available collateral in the form of unencumbered land" (page 17), concluding that "It is important to realize that it is not an innate deficiency in the willingness of small farmers to take risks that hold them back" (page 19). Eswaran and Kotwal (1990), examining the use of credit markets argue that the smoothing of consumption between individuals of different income classes but identical utility functions can be differentiated by scale of operations in terms of credit demand but also observe that "What seems like an inordinate degree of risk aversion may be a merely a reflection of their inability to sustain downswings in income" (Page 480). Bell, Srintvasan and Udry (1997) examining linked credit estimate a credit demand relationship in which demand increases with liquid assets but decreases with fixed assets, a result they state is "both puzzling and unsatisfactory" (page 575). That the sign on liquid assets is positive is at least suggestive of risk rationing behavior, since liquid assets would buffer the collateralized value of fixed assets in case of default. Swain (2002), investigating credit rationing in Puri, India, finds evidence of credit rationing in the conventional sense, but also notes that "the lower number of households demanding loans from the formal sector might be a choice decision of the household… Such households restrict their demand for production loans even if they have access to them" (Pages 4-5). Bhattacharyya (2005) reveals data from West Bengal showing that even in the presence of formal lending, 62.3% of farmers used informal credit with 86% of these willing to pay a substantial premium for not having to give up collateral. Risk rationing can also affect the choices of risk coping mechanisms such as income and consumption smoothing. Morduch (1995) mentions that "Income smoothing is more likely to occur when households anticipate being unable to borrow or insure."

The only study to attempt to place risk rationing in a theoretical context is Boucher, Carter and Guirkinger (2008). Their model is based on asymmetric information that leads to loan contracts with high collateral contracts, whereupon default the farmers lose productive assets. Consequently, the farmer will self-ration out of the market in order to preserve capital. If the farmer is to accept the risk of borrowing it is assumed that external risks can be controlled by some level of effort, but such effort also lowers utility in the good state. The lender offers a suite of contracts with the existence of an insurance contract available to reduce collateral requirements. Incentive compatibility is determined by a mix of high or low interest rates, insurance purchases and collateral. They then go on to show that there is some level of financial wealth (e.g. liquidity) that bifurcates the two economic outcomes. The first is the decisions to not borrow and expend high effort on subsistence activity and the second is to borrow for commercial activities with the potential loss of collateral or costly mitigation through some combination of insurance and high interest rates. Whether a farmer operates risk rationed or under a credit contract depends upon utility in high and low effort states, risk aversion and prudence. [4]

Of those studies that have instrumented field research to identifying risk rationing there is substantial evidence that it is not a trivial matter. In the current paper

[4] On this latter point Boucher et al. (2008) argue that any agent with prudence being three times absolute risk aversion, and wealth greater its critical value will choose risky commercial activities with credit, while those with the same level of wealth but prudence less than three times absolute risk aversion will choose risk-rationed subsistence activities. Those with financial wealth below the threshold will do the opposite. In other words a farmer with low financial wealth but with prudence less than 3 times risk aversion will choose to borrow and undertake risky commercial activity.

we find that 35% of Mexican farmers surveyed are risk rationed. In related research we find 6.5% of Chinese farmers are risk rationed. Barham, Boucher and Carter (1996) report that 32% of Guatemalan farmers surveyed did not apply for credit and were fully constrained in their credit choice due to either transactions costs (transaction cost rationing) or fear of risk leading to self-insure (but without using the term 'risk rationing'). Boucher, Guirkinger and Trivelli (2009) find 8.6% of surveyed Peruvian farmers in 1997 were risk rationed and (with) Fletschner, Guirkinger and Boucher (2012) find 21% to 25% of a resample of Peruvian farmers in 2003 to be risk rationed. Boucher, Carter and Guirkinger (2008) report results from a number of surveys that 19% of Peruvian farmers, 16% of Honduran farmers and 12% of Nicaraguan farmers were identified as risk rationed.

Risk rationing can affect the choices of risk coping mechanisms such as income and consumption smoothing. Morduch (1995) mentions that "Income smoothing is more likely to occur when households anticipate being unable to borrow or insure." implying income smoothing practices are more likely to occur in risk rationed than price rationed. Conservative production decisions one way in which risk rationing smoothes income by limiting their exposure to risk. Other income and consumption smoothing methods include alternative income generating activities, diversification, borrowing, savings and informal insurance agreements.

Under imperfect markets, which are mostly the case in the agricultural sector in developing economies, production risk cannot be diversified away and thus it is not independent of consumption level. Under imperfect markets, or where "capital markets are inefficient" (Masson), jump disutility and its corresponding avoidance behavior is more likely to occur.

The existence of a jump disutility can affect risk taking behavior. According to Masson, under disaster avoidance a risk-averse investor may choose an investment as its variance increases, as long as its lower bound is above the threshold level. Even though this behavior can be found in the absence of disutility jumps, the presence of these can induce this paradoxical behavior. This action relates to Roy's (1952) safety first criterion. Robinson and Lev (1986), referring to Masson's model, provide an example of a firm facing liquidation costs as the source of a disutility jump. They explain that the firm's decisions are to avoid falling below the threshold that causes the disutility jump. An investor may refrain from borrowing, even if he wants to borrow at the market interest rate, if the disutility caused by liquidating assets in case of default is sufficiently large. This approach relaxes some of the more restrictive assumptions in Boucher et al. (e.g. effort differentiation and insurance markets) but also confirms some of the more critical aspects dealing with asset wealth, risk aversion and prudence. In our view it is the exogenously determined probability of default, along with asset values (principally land), that creates a state of disutility to be avoided. A sure way to avoid falling into this state is by not taking a loan. This consideration of preserving wealth by means of minimizing the probability of falling below a threshold income level was first analyzed by Roy in his Safety First model. Moreover, in the economic development context, some implications of a jump disutility, without using this term, have also been described albeit briefly. An important implication is that jump disutilities are indicative of poverty traps, which can alter risk taking behavior of individuals faced by them. If an individual is below the utility jump, he may show excessive risk taking behavior if his safe production activity would not generate the necessary income to reach the jump. Under this case, a high-risk high-return activity provides a positive probability of asset accumulation. These dynamics of wealth on risk taking behavior and multiple equilibria derived from a disutility jump are analyzed by Lybbert and Barrett (2011) under the context of poverty traps. By the same token, this paper investigates risk taking behavior of farmers located to the right hand side of the disutility jump. Similar research in the development field where the risk taking behavior of farmers just above the poverty trap is analyzed includes Barrett et al. (2006), Hoddinott (2006), McPeak (2004), and Zimmerman and Carter (2003). Under multiple equilibria, and following Mason's utility jump, these farmers would safeguard their productive assets by pursuing asset smoothing instead of consumption smoothing strategies.

Another characteristic of risk rationing is the discount factor of future consumption. Risk rationing refrain from engaging into the risky activity by not borrowing; this forgone expected increase in revenues due to the commercial activity is compensated by current consumption, implying a larger discount factor than price rationed under homogeneous production and individual characteristics. Taking the risky commercial activity means sacrificing current consumption for future one. According to Pender (1996), the discount factor, or inter temporal rate of substitution, can be affected by marginal utilities of consumption or by time preference. He continues to say that under binding credit constraint borrowers' discount rate is higher than the market interest rate. In his paper, he looks at the ratio of marginal indirect utilities of initial wealth and future wealth as a measure of the discount factor. Alternatively, we can look at the utility of initial wealth for two identical individuals that have the same expected returns. That with the higher utility at initial wealth level prefers current consumption more. Risk rationed people are expected to have a higher initial utility, reflecting in part their time preference for consumption.

One objective of this study is to investigate the extent of risk rationing amongst Mexican farmers. However, we present a model with a somewhat different structure from Boucher et al. (2008) preferring to develop risk rationing around the exogenous risk conditions that give rise to a jump in utility functions. If a firm's loss due to asset liquidation is sufficiently large, it may exhibit a jump discontinuity at a critical income level. Falling below that level would force the firm to liquidate assets in order to meet its obligations. Masson (1974) provides evidence of a utility function with a discontinuity in the form of a vertical jump, representing a large loss in utility due to income falling below a critical level. He makes analogies that the threshold is some situation that will lead us into an undesirable state of nature and thus cause a large disutility, like a divorce or being declared bankrupt. In this model, people get utility from both: income (or any variable of interest), and the state of nature. The different states are defined by being above or below the threshold level.

The second objective of this paper is to a model for risk rationing based on a jump disutility model. We show that a jump disutility requires the incorporation of third moments of the distribution of returns, or any variable of interest. The model is tested using data from Mexican grain farmers from a survey in 2011. With the responses on lowest and highest possible, and expected yield and price for their crops, we simulated the revenue mean, variance and skewness using a Pert distribution. Our results suggest that risk rationing can be modeled as having a jump disutility. Preference for risk rationing depends on the difference in the expected return distribution moments of the two states (debt and no debt). Our results suggest that risk rationed have a stronger preference for skewness than borrowers (price rationed), but not necessarily for the first two moments. Also, the utility at their initial level of wealth is higher for risk rationed, suggesting that their discount rate is larger than price rationed. Our results provide elements for policies to integrate risk rationed into the formal credit market.

***Risk Rationing and Jump Discontinuity***

The concepts of a utility function with a jump discontinuity and risk rationing are, we argue, closely related. Risk rationing refers to an individual who, in spite of his willingness to borrow from financial institutions at the market interest rate, refrain from borrowing for fear of losing collateral. The probability of losing collateral creates a large disutility at the point where his revenues cannot cover the debt repayment. We can think of this disutility as a large vertical drop in utility caused by the collateral loss. The collateral loss, or jump disutility, depends on the size of the loan and on the divisibility of the collateral.

Models that incorporate jump disutility relate the jump to a variable of interest reaching certain threshold value; however, the disutility is not caused directly by income falling low, but by the resulting state created by it. Low income triggers a disutility caused by another variable. In Robinson and Lev (1986), this variable is liquidation costs; In Masson (1974), it is the state of being declared bankrupt (figure 5.1).

The connection between income and loss of wealth resulting in a disutility jump can be illustrated as a firm that cannot meet its debt obligations and is forced into asset liquidation. This can occur if a firm's total revenue is less than its total costs. A firm will be indifferent between producing or not if their total revenue equals its total costs, but it will shut down if its total costs are not covered by its total revenue in the long run. From this condition we can have a relationship between revenue and liquidation loss. If $TR < TC$, or consequently if the ratio $\frac{TR}{TC} < 1$, the firm will shut down and liquidate assets to pay its debt obligations. The amount of assets that the firm must liquidate, and all its associated costs, is the loss in total wealth of the firm and the source of jump disutility. The greater the firm's financial obligations, the larger the wealth loss in case of default. The size of the utility discontinuity is directly related to the amount of fixed assets that a firm should liquidate in order to pay its obligations; if the liquidation of assets is large enough the firm may decide not to enter into the credit market, and thus become risk rationed. The firm will not borrow if the disutility associated to asset liquidation is deemed to be sufficiently large. Masson's discontinuous function does not capture the interaction between income and wealth loss, it assumes that a given level of income the disutility occurs. To better understand the relationship of income (or revenue) and asset liquidation, we need to include a function of wealth over the ratio $\frac{TR}{TC}$, and a utility function of wealth given that ratio.

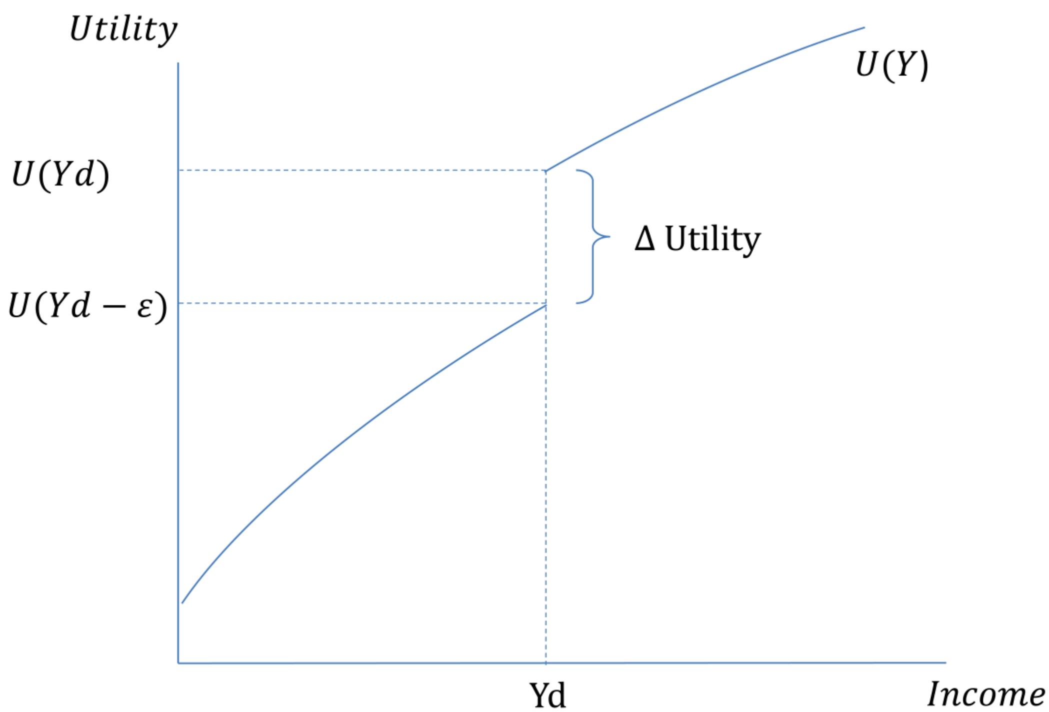


Figure 5.1 Masson's jump utility function.

Assume the profit function of an individual is the following:

$$\pi = \alpha + R(l,r,d) + py - C(w,y) - D$$

[1]

where $\alpha$ is the initial wealth, or savings, $R(l,r,d)$ is revenue from labor, $l$,remittances, $r$, and amount borrowed, $d$;$py$ is revenue from farm operations, output price is $p$ and output $y$;$C(w,y)$ is the cost function of the farm and $D$ is the debt repayment, if any.

Total wealth at the end of period, t = 1, becomes:

$W_h = \pi_1$ if $TR \geq TC$ at period t = 0

[2]

$W_l = \pi_1 - L$ if $TR < TC$ at period t = 0

Where $L$ is the value of the land or total fixed assets that must be liquidated to repay the loan. When the firm's total revenue is less than its total costs, it will liquidate its assets to pay for any debt obligations it may have incurred.

$$TR = TC \rightarrow R(l,r,d) + py = C(w,y) + D - \alpha \rightarrow \frac{(R(l,r,d) + py)}{(C(w,y) + D - \alpha)} = 1$$

We use $\gamma$ to capture the ratio $\frac{TR}{TC}$ and the different states of the world. As long as $\gamma \geq 1$, equation [2], the firm will be able to repay its loan obligations and will not be forced to shut down operations. Liquidation of assets occurs if $\gamma < 1$. The amount of asset loss due to liquidation is proportional to the amount of loan, $D$. Assume $L > D$, $L$ is indivisible and is used fully as collateral for $D$. Let the liquidation cost in case of $\gamma < 1$ be $L$ for simplicity. Assuming $d < D$, borrowing decreases the value of $\gamma$; thus, increasing the chance of liquidating assets.

A liquidation of assets represents a loss in total wealth for the producer. At $\gamma = 1$, a small decrease, $\varepsilon > 0$, in $\gamma$ will trigger the wealth loss. This is shown in figure 5.2. Unlike this model, however, the jump disutility can also result from being in a different state of the world not necessarily dependent on wealth changes.

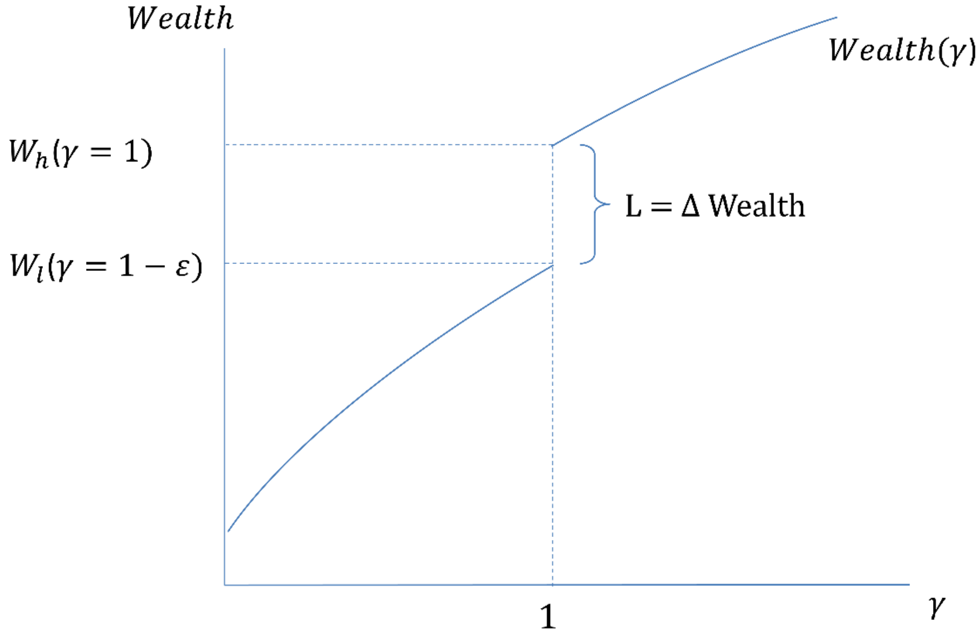


Figure 5.2 Wealth with respect to γ, good and bad state at right and left side of γ=1.

Now that we have a relationship of wealth and $\gamma$ we can have a utility function of wealth dependent on $\gamma$.This utility function exhibits not only a vertical discontinuity at a given level of wealth, but also a change in wealth that separates the good and bad state of nature. Looking at figure 5.3, the point b is where $\gamma = 1$, the limit of the "good state". Once $\gamma$ drops below 1, the function takes the value at point a, the upper limit of the "bad state". The separation of the two states occurs if a person borrows and has to liquidate his assets to repay a loan. The vertical jump from b to a is the change in utility from being at either state. This disutility is caused by the asset loss needed to meet obligations, represented by the horizontal gap between points a and b. If this gap in wealth is related to the indivisibility of land, uncertainty of cash flows or current level of wealth; then, if a risk rationed individual can use other assets than his land as collateral, if he has a revenue insurance product, if he has other sources of income, or if there is a government policy that provides him with a steady cash transfer, then a risk rationed may engage into a higher expected yield enterprise, i.e. become price rationed.

There may also be some disutility caused by the stigma of being at the bad state, like Masson suggested, but for the purpose of this paper we exclude it from the analysis; however, this stigma could cause a downward shift of the segment of the utility function left of point a, and thus, increase the jump, assuming marginal utilities are invariant in any state. Otherwise, the slope of the utility function may change as well.

For a risk rationed, it is assumed that the starting value of $\gamma$ is on the right of 1. When the starting value is located to the left side of 1, the individual could behave as risk seeker. His expected revenue distribution becomes positively skewed. At the "bad state" farmers may not have access to formal credit; nonetheless they may seek a production technology that offers them the highest variance to have a positive probability of reaching $\gamma = 1$, and so be above the threshold level or in the "good state".

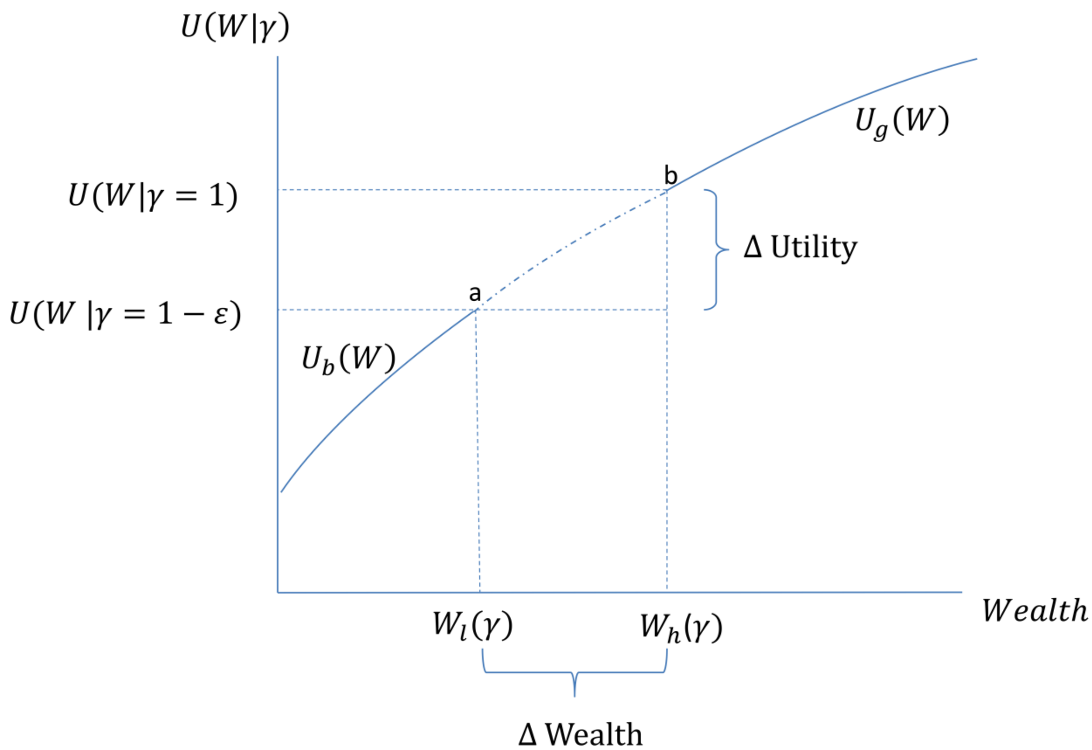


Figure 5.3 Utility function of wealth with a discontinuity given $\gamma$

The relationship between the indirect variable, $\gamma$; the direct variable, wealth; and the utility function, is shown in figure 5.4.Quadrant 1 shows utility as a function of $\gamma$. The loss in utility, J, occurs once $\gamma$ is at the threshold level. This loss in utility is the result of the loss of assets, L, from liquidation when of $\gamma < 1$, this is shown in figure 5.2 and quadrant 4 in figure 5.4. Quadrant 2 shows the relationship of utility and wealth when facing liquidation costs. The discontinuity is derived from the loss of wealth, L, and utility, J.

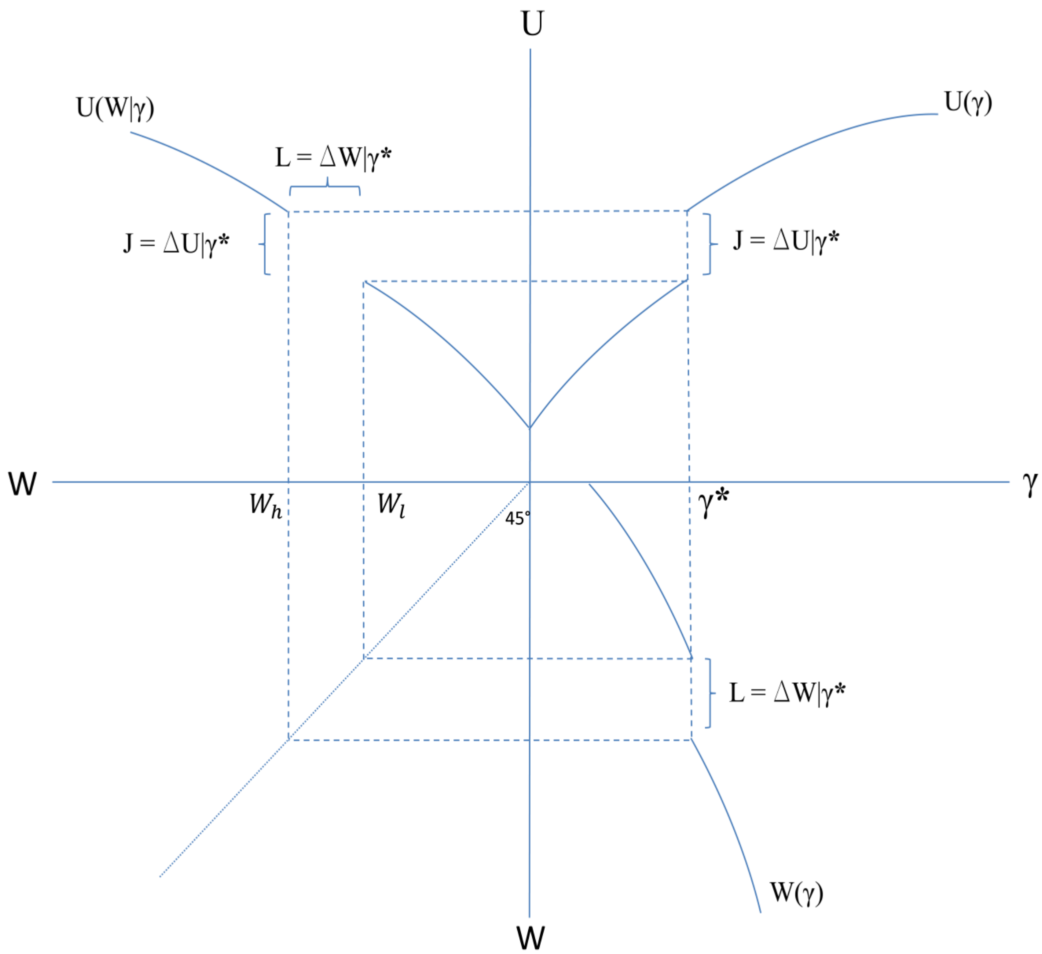


Figure 5.4 Multi-Quadrant derivation of a utility function with jump disutility and wealth loss.

The relationship of utility, wealth and the indirect variable, $\gamma$, can be expressed first as wealth as a function of $\gamma$, and then as the utility of wealth at each of the two states of nature. Looking at quadrant IV, the good state is at the left of $W_h$, and the bad state at the right of $W_l$. Summarizing [1] and [2], and following Lev and Robinson's ad hoc decision rules, we have:

$$W = \begin{cases} \pi & for\ \gamma \geq 1 \ \ (good\ state) \\ \pi - L & for\ \gamma < 1 \ \ (bad\ state) \end{cases}$$

$$V(W) = \begin{cases} U(\pi) & for\, \gamma \geq 1 \;\; (good\ state) \\ U(\pi - L) & for\, \gamma < 1 \;\; (bad\ state) \end{cases}$$

Where the ad hoc decision rule to maximize is:

$$Max\ V(W) = U(\pi)\big(1 - F(\gamma < 1)\big) + U(\pi - L)F(\gamma < 1)$$

[3]

Solution of [3] is equivalent to Roy's safety first model, since we are minimizing $Prob(\gamma < 1)$.

Equation [3] refers to a price rationed individual; he is taking the loan and thus it incurs into a positive probability of losing L. This doesn't mean that by not taking a loan the probability of liquidation, or $\gamma < 1$, is not positive. This probability may in fact be positive, but the size of L may not be significant as to create a disutility jump. From this we can assume that for a small enough L, the utility function of a risk rationed, or non-borrower, is continuous over wealth. However, we should consider the cases where the individual's utility function changes by taking the loan or not, and also his expectation on the distribution of revenues in the case of taking the loan or not. We could also expect that taking a loan increases the probability of higher returns. If this is so, then we have four different scenarios:

1) Utilities don't change between states (debt and no-debt), and neither does return distributions.

2) Utilities between states are the same, but return distributions differ by state.

3) Utilities are different between states, and return distributions are same.

4) Utilities are different between states, and return distributions are different too.

As an illustration of scenario (2), Figure 5.5 shows the same utility function of an individual in the two states, debt and no-debt, and only their revenue distribution changes between states. Since price rationed are those who borrow formally, we would expect that their upper bound on returns to be higher than under no debt. Also, we would expect that their benefits of increase revenue outweigh the cost of losing their collateral. That increase in expected revenue is reflected in Figure 5.5 as an increase in the upper bound of wealth from $W_{nd,M}(\gamma)$to $W_{d,M}(\gamma)$, with a corresponding increase in utility at the upper bounds from $U(W_{nd,M}|\gamma)$ to $U(W_{d,M}|\gamma)$. Borrowers would face the wealth loss of $W_{d,h}(\gamma) - W_{d,l}(\gamma)$ with the corresponding jump disutility of $U(W|\gamma = 1) - U(W|\gamma = 1 - \varepsilon)$.

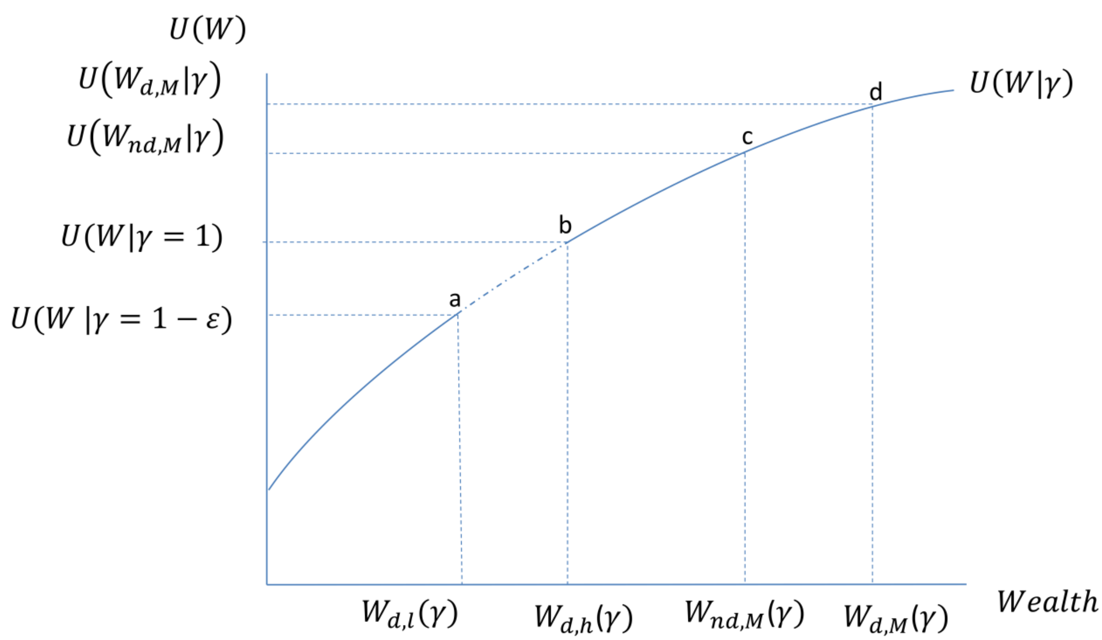


Figure 5.5 Utility function of a risk and price rationed individual under different revenue distributions.

The expected utility of a borrower is the integral from 0 to the higher upper bound of wealth $W_{d,M}(\gamma)$ minus the expected disutility created by the jump.

$$E[U(W^d)] = \int_0^{W_{d,M}} U(W\mid\gamma)\varphi_d(\gamma)d\gamma \qquad [4]$$

$$= \int_0^{W_{nd,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma - \int_{W_{d,l}}^{W_{d,h}} U(W\mid\gamma)\varphi(\gamma)d\gamma + \int_{W_{nd,M}}^{W_{d,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma$$

The expected utility of a non- borrower is the integral from the origin to the maximum expected revenue under no debt.

$$E[U(W^{nd})] = \int_0^{W_{nd,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma \qquad [5]$$

An individual is risk rationed if EU$(W^{nd})$> EU$(W^d)$.

$$\int_0^{W_{nd,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma > \int_0^{W_{nd,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma - \int_{W_{d,l}}^{W_{d,h}} U(W\mid\gamma)\varphi(\gamma)d\gamma + \int_{W_{nd,M}}^{W_{d,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma$$

EU$(W^{nd})$> EU$(W^d)$=$\int_{W_{d,l}}^{W_{d,h}} U(W\mid\gamma)\varphi(\gamma)d\gamma > \int_{W_{nd,M}}^{W_{d,M}} U(W\mid\gamma)\varphi(\gamma)d\gamma$

Similar analyses follow for the other three scenarios.

***Effect of Higher Moments in the Expected Utility Function of a Risk Rationed Individual.***

The justification for including the third moment in the utility function is provided next. The drop in utility caused by the possibility of collateral loss has the effect of reducing the skewness of the expected revenue distribution. The reason for this is that there is a probability shift from the value of $\gamma$ that triggers the collateral loss to the values of $\gamma$ with the loss incurred. These values are to the left side of the trigger values, thus, shifting probability weights toward the left tail of the distribution. Rothschild and Stiglitz (1970) mention that a density function created from another one by taking probability weight from the center and adding it to the tails becomes more variable. In our case, however, the probability function created by shifting weights to the left tail not only becomes more variable, but also more negatively skewed.

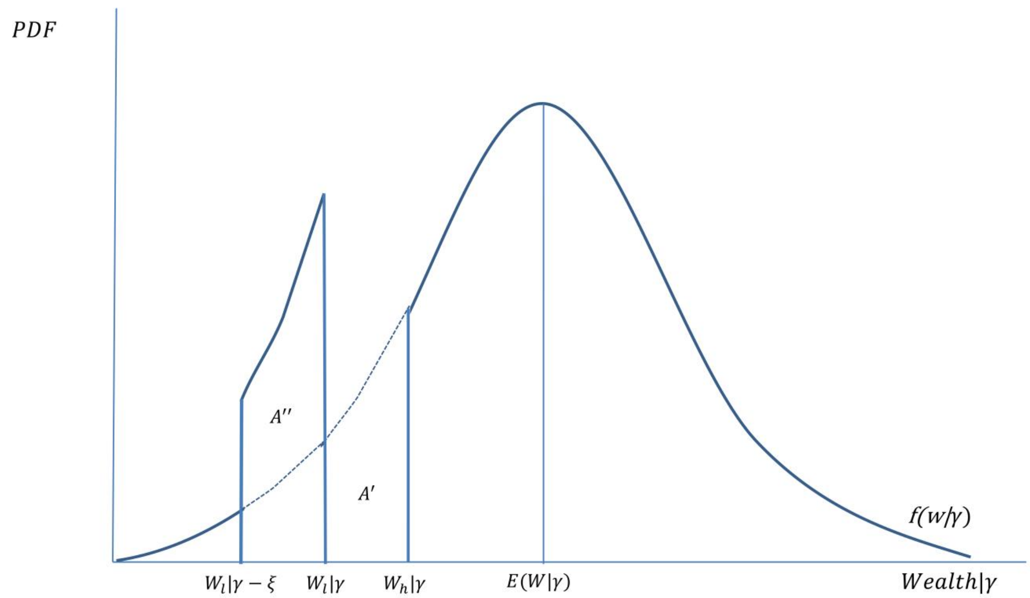


Figure 5.6.Probability shift from A' to A" for borrowers under jump disutility.

Figure 5.6 shows a probability transfer towards the left tail of the expected wealth distribution as described in equation [2]. The area $A' = \int_{W_l}^{W_h} f(w|\gamma)dw$ is the probability of wealth being in the gap between $W_h$ and $W_l$. This is the loss of wealth due to collateral liquidation. The borrower cannot attain the wealth values between $W_h$ and $W_l$ anymore, the probability of being between them is transferred, from $A'$, to the left of $W_l$ at $A''$. How spread is the new added probability at the left of $W_l$ is unknown. However, we can denote the spread as being a positive number, $\xi$.

Regardless of the value of $\xi$, the new distribution would have more weights towards its left tail, thereby decreasing skewness.

Distribution of wealth might appear bimodal (or multimodal) amongst risk rationed, particularly if some of them used to be borrowers and lost collateral; while for borrowers it may appear unimodal.

Following the justification, we can characterize the expected utility model of an individual through a third-order Taylor expansion over $\gamma$. The expected utility function of wealth depends on the current level of wealth and on the distribution of $\gamma$. The incorporation of the third moment into the expected utility function is the result of the shape of the distribution of $\gamma$: the starting value of $\gamma$, $\bar{\gamma}$, plus the random term $\tilde{\gamma}$.The distribution of $\tilde{\gamma}$, $\psi$,is characterized by its first three moments: $\tilde{\gamma} \sim \psi(\mu, \sigma^2, m^3)$, where $\mu$ is the distribution mean, $\sigma^2$ its variance, and $m^3$ its third moment or unstandardized skewness. The jump disutility of $\gamma$ creates negative skewness in its distribution. This jump process transfers risk from the right side to the left side of $E(\tilde{\gamma})$. For the same reason that limiting downside risk increases skewness, increasing downside risk decreases it.

The inclusion of the third moment of a distribution in the utility function reflects the downside risk of a random variable. A positive skewness decreases downside risk, while a negative one increases it. Menezes et al. (1980) gives a general definition of increasing downside risk as the following: “one distribution has more downside risk than another if it can be obtained from the other by a sequence of probability transfers which unambiguously shift dispersion from right to the left without changing the mean and variance.” Cain and Peel (2004) studied the preference for gambles and state that a risk-averse person has a preference for skewness; moreover, a tradeoff exists among mean, variance and skewness. People are willing to trade a negative expected mean of returns for a positive skewness. According to Golec and Tamarkin (1998), the preference for skewness can be sufficiently large that even though people are faced with negative expected return and high variance on a gamble, they would still take the gamble as long as the skewness is sufficiently large. Peel (2012), on the other hand, provides examples where given different characteristics of lotteries and utility functions, risk-averse individuals do not necessarily prefer a more skewed distribution with equal mean or variance. However, investor's preferences for skewness in returns are so common that there exist many mechanisms in the market to increase positive skewness of returns. Tsiang (1972) cites limited liability, prearranged stop-loss sales on stocks, and put and call options as examples of market mechanism to increase positive skewness of returns. Diminishing the magnitude of a financial loss and increasing the magnitude of the gain are ways to increase the skewness of returns. Similarly, increasing the size of a loss and limiting gains decrease the skewness of the return distribution, which is avoided by investors. This can occur if the income level of a firm is sufficiently low that it may be forced into bankruptcy and into liquidation of assets. The size of the loss in assets due to liquidations is related to the amount owed to creditors.

The expansion of the utility function of wealth over $\overline{\gamma}$ becomes:

$$E[U(W|\gamma)] = U(\overline{\gamma}) + U'(\overline{\gamma})\mu + \frac{U''(\overline{\gamma})\sigma^2}{2} + \frac{U'''(\overline{\gamma})m^3}{6} \qquad [6]$$

Where $U' > 0, U'' < 0,\ U''' > 0,\ E(\gamma - \bar{\gamma}) = \mu, E(\gamma - \bar{\gamma})^2 = \sigma^2$,

$E(\gamma - \bar{\gamma})^3 = m^3$, and $E\left(\frac{\gamma-\bar{\gamma}}{\sigma}\right)^3 = Sk$ is the standardized skewness. Higher order terms are not considered in this analysis. After multiplying the second and third moments of [6] by $\frac{U'}{U'}$ and $\frac{U'U''}{U'U''}$ respectively, and standardizing the skewness, we transform [6] as a function of risk aversion and prudence.

$$E[U(W|\gamma)] = U(\bar{\gamma}) + U'(\bar{\gamma})\mu - \frac{1}{2}U'(\bar{\gamma})R\sigma^2 + \frac{1}{6}U'(\bar{\gamma})RPSk\sigma^3$$

$$= U(\bar{\gamma}) + U'(\bar{\gamma})[\mu - \frac{1}{2}R\sigma^2(1 - \frac{1}{3}PSk\sigma] \qquad [7]$$

Where $R = -\frac{U''}{U'}$ is the Arrow-Pratt absolute risk aversion coefficient, and $P = -\frac{U'''}{U''}$ is the absolute prudence coefficient (Kimball, 1990). The effect of the change in expected revenue, (or however $\gamma$ is defined) on expected utility is $\frac{\partial E[U(W|\gamma)]}{\partial \mu}$ = $U'(\bar{\gamma})$ > 0, due to local non-satiation. The effect of revenue risk on expected utility is $\frac{\partial E[U(W|\gamma)]}{\partial \sigma} = - U'(\bar{\gamma})R\sigma + \frac{1}{2}U'(\bar{\gamma})RPSk\sigma^2 \lesseqqgtr 0$. When skewness is 0, the derivative is negative except under risk neutrality, that is, when $R = 0$. If $R$ and $P > 0$, the derivative can be positive when skewness is positive and sufficiently large, i.e. when $\mathrm{Sk} > \frac{2}{P\sigma}$.This is consistent with a case stated by Masson where an individual may prefer a production technology with a larger variance as long as the mean return of the two technologies is the same and the riskier technology does not fall below a minimum threshold. If a riskier production technology is left bounded, which increases its skewness, a person may in fact prefer it. Skewness has a positive effect on expected utility, $\frac{\partial E[U(W|\gamma)]}{\partial \mathrm{Sk}} = \frac{1}{6}U'(\overline{\gamma})RP\sigma^3 \geq 0$, except again, under risk neutrality, or prudence neutrality (when $U''' = 0$). The derivative increases with variance when both $R$ and $P > 0$. This is equivalent to say that the larger the downside risk aversion coefficient is, $D = RP$ (Modica and Salvatore, 2005), the larger the preference for skewness. As long as $D = \frac{U'''}{U'} > 0$, skewness increases expected utility under larger variance.

When prudence equals $\frac{3}{Sk\sigma}$, the expected utility function is characterized by the first moment only. If it is greater than that, a larger risk aversion values would increase expected utility. In a similar way, when prudence is lower than $\frac{3}{Sk\sigma}$, a larger risk aversion would decrease expected utility. Prudence would increase expected utility as long as skewness is positive.

The three-moment expected utility also affects risk premium through skewness. The risk premium is equivalent to $E[U(W + e)] = U(W - \pi)$, where $e \sim f(\mu, \sigma^2)$ is the distribution of the gamble's outcome and $\pi$ is the risk premium willing to pay in order to avoid the gamble $e$. Under mean-variance analysis, the risk premium is approximated as $\pi = \frac{1}{2}\sigma^2 A - \mu$, where $A$ is the Arrow-Pratt coefficient of absolute risk aversion. Similarly, for a three-moment expected utility, the risk premium is $\pi = \frac{1}{2}\sigma^2 A - \frac{1}{6}\sigma^3 DSk - \mu$. When skewness increases, risk premium decreases, as long as $D > 0$.

The state of being risk rationed or price rationed is endogenous to each individual. We assume that they have complete information about their production technologies and risks, from which they base their decision to be in either state. So far we have not specified the form of the utility function since for the purpose of explaining the decision to be risk rationed, it is sufficient to have the general form. The utility functions, however, can differ at each state. That is, the utility function of a risk rationed may be different from that of a price rationed. The resulting expected utility for each state is derived from the interaction of the utilities functions along with the distribution of expected returns

A Farmer's decision to beat each state can be summarized as follows. Suppose that each farmer starts with the decision to borrow or not at time 0. At this point he has the opportunity to borrow, and he indeed wants to borrow, in order to adopt a higher yield technology with higher expected returns; or he can choose not to borrow and produce with a lower yield technology if he deems that the probability of default is large enough as to force him to liquidate his assets in order to repay if default occurs. That doesn't mean that farmers do not consider borrowing -they do want to borrow and have access to credit- but the disutility caused by the collateral loss risk is greater than the utility gained from the higher expected returns. The extra revenue from using the high yield technology does not compensate for the probability of losing collateral in case of a bad scenario. These people are risk rationed. If, on the other hand, the disutility from the probability of losing collateral due to default is lower than the utility gained from the higher expected returns generated by the adoption of the high yield technology, then this farmer would be price rationed. Therefore, the farmer has two options based on his utility function and on his risk assessment of returns.

***An Empirical Investigation of Risk Rationing and Jump Processes amongst Mexican Farmers***

In this section we investigate the characteristics of risk and price rationing using a random utility model. Dichotomous variable indicating credit rationing status is used as dependent variable, and the first three moments of the expanded expected utility as independent variables.

To accomplish this, a survey to unambiguously instrument credit status was specifically designed (see Figure 5.8 for a schematic of the survey). This survey divided individuals into three mutually exclusive groups: risk, price and quantity rationed. Quantity rationed are those people who requested a loan but the lender did not offer any amount or a lower amount than requested. They are externally rationed. As previously defined, risk rationed are those people who do not borrow, or borrow less than offered, for fear of losing collateral; while price rationed are those who borrow or refrained from borrowing for reasons other than fear of collateral loss. These two groups are internally determined by the borrower. The survey was designed specifically to identify respondents who are risk, price or quantity rationed and meticulously created to eliminate any ambiguity and to instrument against problems of unobserved endogeneity.

We derive the econometric specification, identification strategy, and hypothesis generation from the above theory. Under the random utility framework, a farmer would decide not to borrow if his expected utility from not borrowing is larger than that from borrowing; that is, if $E_R[U(w|\gamma)] > E_P[U(w|\gamma)]$. The subscript $R$

stands for risk rationed and $P$ for price rationed. The probability that risk rationing is chosen, $\Pr(R=1)$, is then:

$$\Pr\left\{U_R(\bar{y})+U_R'(\bar{y})\mu_R+\frac{1}{2}U_R''(\bar{y})\sigma_R^2+\frac{1}{6}U_R'''(\bar{y})m_R^3+\varepsilon_R>U_P(\bar{y})+U_P'(\bar{y})\mu_P+\frac{1}{2}U_P''(\bar{y})\sigma_P^2+\frac{1}{6}U_P'''(\bar{y})m_P^3+\varepsilon_P\right\}$$

$$\Pr\left\{\varepsilon_P-\varepsilon_R<U_R(\bar{y})-U_P(\bar{y})+U_R'(\bar{y})\mu_R-U_P'(\bar{y})\mu_P+\tfrac{1}{2}[U_R''(\bar{y})\sigma_R^2-U_P''(\bar{y})\sigma_P^2]+\tfrac{1}{6}[U_R'''(\bar{y})m_R^3-U_P'''(\bar{y})m_P^3]\right\}$$

[8]

The probability of choosing not to borrow is given by the cumulative distribution function (CDF) of $(\varepsilon_P-\varepsilon_R)$ to the point of the right hand side of [8]. That is,

$$\Pr(R=1)=F\left\{U_R(\bar{y})-U_P(\bar{y})+U_R'(\bar{y})\mu_R-U_P'(\bar{y})\mu_P+\tfrac{1}{2}[U_R''(\bar{y})\sigma_R^2-U_P''(\bar{y})\sigma_P^2]+\tfrac{1}{6}[U_R'''(\bar{y})m_R^3-U_P'''(\bar{y})m_P^3]\right\}$$

[9]

Equation [9] can be estimated using a linear probability, probit or logit model. The independent variables are the moments of the expected distributions of returns for each state. The dependent variable is a dummy variable with a value of 1 if the individual is risk rationed, and 0 for price rationed as instrumented by the survey. The estimated coefficients are the utilities and its first three derivatives for each state, however, the constant term would be the difference in utilities at the initial wealth level. Going back to the four scenarios previously mentioned, we can test for different utilities functions or their derivatives by solving [9]and testing for differences in coefficients. On the other hand, if we believe that the moments are invariant between states, then the only source of differences in expected utility would be different utility functions. The probability of being risk rationed under the assumption of invariant moments becomes:

$$\Pr(R=1)=\mathrm{F}\left\{[U_R(\bar{y})-U_P(\bar{y})]+[U_R'(\bar{y})-U_P'(\bar{y})]\mu+[U_R''(\bar{y})-U_P''(\bar{y})]\tfrac{\sigma^2}{2}+[U_R'''(\bar{y})-U_P'''(\bar{y})]\tfrac{m^3}{6}\right\}$$

[10]

Model [10] can be justified if there are no significant differences between the moment distributions at each state. The coefficients in [10] now become the differences in coefficients between states. A coefficient that is not significantly different from zero means that it cannot explain the state preference between risk rationed and price rationed. As in [9], the constant term is the difference in utilities at the initial wealth level. The rest of the coefficients are also measured at the initial wealth, $\bar{y}$. If the coefficients of [10] are different from zero, each state would have a different utility function. Our data supports the use of model [10].

If the moment distribution is different across states but with equal utility function and initial wealth, the equation to solve becomes:

$$\Pr(R=1) = F\{U(\bar{y}) + U'(\bar{y})(\mu_R - \mu_P) + U''(\bar{y})\tfrac{1}{2}(\sigma_R^2 - \sigma_P^2) + U'''(\bar{y})\tfrac{1}{6}(m_R^3 - m_P^3)\} \quad [11]$$

Again, we can test for different utilities and its derivatives between states by testing the corresponding coefficients of [9].

Once we have estimated the coefficients we can proceed to analyze some characteristics for each group. For instance, if model [9] is used we can estimate the values of the utility at initial wealth, and expected marginal utilities for each group. By dividing the utility at initial wealth by the expected marginal utility of each group we can get their discount factor (Pender, 1996). Also, by dividing the expected marginal utilities of each group we get the marginal rate of substitution between groups. This tells us the amount of expected income that can be given up in one state in exchange of one unit of expected income in the other while keeping utility constant. In other words, this is the value of expected income in one group measured in a unit of expected income in the other. Risk aversion, prudence and downside risk aversion coefficients can also be estimated by using model [9]. If model [10] is used, the analysis is more limited since the coefficients are the difference of utilities and its expected moments between groups. The constant coefficient can tell us which group has a stronger preference for current consumption, implying a larger discount rate. If the value of the coefficient is positive, it means that risk rationed get more utility than price rationed at the initial wealth level, or at the present.

Similar to the marginal rate of substitution between expected incomes of the two states, the difference of expected marginal utilities can tell us which state requires values expected income more, but not the actual price ratio like the marginal rate of substitution. This difference in marginal utilities indicates the expected income preference under risk. A small value means that an individual can easily substitute expected income between the two states, and then the state preference will depend on the higher moments.

In figure 5.7, the horizontal axis is the expected income under risks rationed, while the vertical is under price rationed. The slope of the indifference curve is the units of expected income that should be given up under price rationed for one unit under risk rationed.

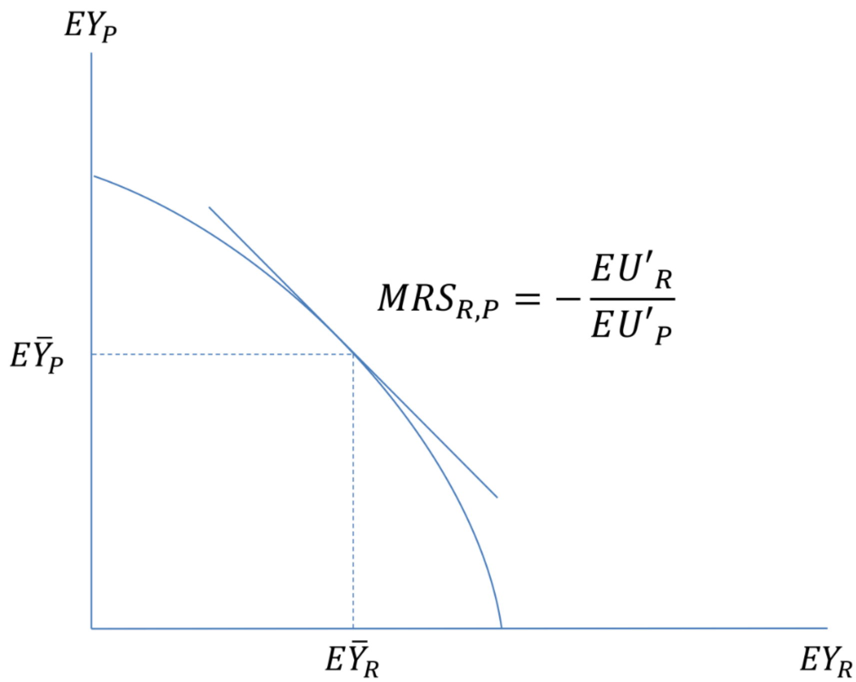


Figure 5.7.Marginal rate of substitution of expected income between each state.

***Comparative Statics of Demand for Credit under a Jump Utility Model with Intertemporal Consumption.***

Here we analyze the effects of key parameters on demand for credit for a farmer with a jump disutility using an intertemporal utility model. This section is to illustrate some comparative statics on demand for credit, and show how the discount rate is obtained. Similar to Pender (1996), we created a credit constraint where a farmer faces liquidation costs under a probability of default. We estimate the effect of assets, non-farm revenue, and expected farm revenue on credit demand. Assume the farmer has initial assets $\alpha$, which includes land value. He complements his income by non-farming activities, $R$. He decides how much to borrow, $d$, before the planting decision. After harvest, he receives farm income $\tilde{y}$ with distribution $f(\tilde{y})$. He also repays his formal loan at the market interest rate, $(1+r)d$, but if his total income cannot meet the debt obligation, he is forced into liquidation of assets $L$. The probability of default is $F(\gamma)$. The farmer has savings rate of $K$ for the assets at first period. His formal credit line is limited by $D$. The farmer's problem becomes:

$$Max_{d<D} U_1(\alpha + R + d) + EU_2[\tilde{y} - (1+r)d - LF(\gamma) + K(\alpha + R + d)] + \lambda(D - d)$$

[12]

Applying the envelope theorem to [12] we obtain the effects of the different parameters on credit demand. The effect of non-farm income on credit demand is negative if the marginal expected utility of non-farm income is greater than the expected marginal utility of debt, as long as $\frac{\partial y}{\partial d} + K > (1+r) + L\frac{\partial F(\gamma)}{\partial d}$ , that is, if the marginal farm income from investing the loan plus savings rate is greater than marginal probability of default from an increase in debt times liquidation cost plus the market interest rate. In other words, if the farmer's expected marginal utility of non-farm income is greater than his expected marginal utility of debt, then his demand for formal credit would increase as his non-farm income increases if the liquidation costs are large, or the probability of default is high. This reflects the effect of a buffer cash to cope with bad outcome. This interaction is complex, but one of the main factors is increase in expected farm income, liquidation cost and probability of default. The effect of $LF(\gamma)$ is the dominant force in determining credit demand for risk rationing;

however, the interaction with the rest of the parameters will ultimately decide the credit demand. Demand for formal credit given non-farm income is:

$$\frac{\partial d}{\partial R} = \frac{EU_R'(C_2)\left(L\frac{\partial F(\gamma)}{\partial R}-K\right)-U_R'(C_1)}{\{EU_R'(C_2)-EU_d'(C_2)\}\left(\frac{\partial y}{\partial d}+K-(1+r)-L\frac{\partial F(\gamma)}{\partial d}\right)} \quad [13]$$

The Lagrange multiplier is $\lambda^* = U_d'(C_1) + EU_d'(C_2)\left(\frac{\partial y}{\partial d} + K - (1+r) - L\frac{\partial F(\gamma)}{\partial d}\right)$, and $C_1, C_2$ are consumption at each period.

$\lambda^*$ is positive if the marginal farm income from investing the loan is greater than marginal probability of default times liquidation cost. Normally this is the case, unless the probability of default is large.

How expected farm income affects credit demand depends also on the probability of default and liquidation cost, but also on the difference in expected marginal utilities of farm income and debt. If this difference is large enough, it would require a high savings rate for expected farm income to have a negative effect on credit demand. If both expected marginal utilities are close in value, credit demand would increase as $\frac{\partial y}{\partial d}$ increases.

Similar results hold for the effect of assets on credit demand. Asset wealth creates a safety net for borrowing that even with high probability of default credit demand is positive.

One characteristic of risk rationed is that they forego the chance of higher future income, by not taking the risky activity. This may be also caused by time preference of consumption. Although risk rationing may exhibit larger discount rate than price rationing, we believe this is a sufficient but not a necessary condition for risk rationing. Large discount rate can explain risk rationing behavior, but as mentioned before, many other factors affect that decision. Pender defined the discount rate (1+d) as the ratio of the marginal utilities between states 1 and 2, the smaller (1+d), the larger future consumption is discounted. His discount rate is obtained from the Taylor expansion of $V(w,\tilde{y})$, the function that solves the UMP. The expansion becomes: $(w,\tilde{y}) + x\frac{\partial V(w,\tilde{y})}{\partial w} \cong V(w,\tilde{y}) + (1+d)x\frac{\partial V(w,\tilde{y})}{\partial \tilde{y}}$. Pender defined $x$ as the present reward and $(1+d)x$ as the future reward. For a small $x$, the Taylor expansion provides an approximated solution.

In our model, the discount rate is $(1+d) = \frac{\frac{\partial V(w,\tilde{y})}{\partial w}}{\frac{\partial V(w,\tilde{y})}{\partial \tilde{y}}} = \frac{U_w'(C_1)+EU_w'(C_2)[\frac{\partial y}{\partial w}+K]}{EU_y'(C_2)}$.

The time preference depends on the expected utility from farm income, as well on the expected utility of certain wealth, w, and the savings rate. Unless $EU_y'(C_2)$ is very large, risk rationing would prefer current consumption.

These models show that the demand for credit is the result of complex interactions. When demand for credit decreases for a given set of parameters, we can say that the individual is approaching risk rationing status, or is currently quasi-risk rationed. The advantage of our study is that we are not looking at those people who have diminishing demand for credit, but instead look at the determinants of risk rationing. This analysis is possible because we used a specific survey to unambiguously determine credit rationing status.

***Data and Empirical Results***

The data used in this paper was collected from a survey of Mexican grain farmers that we conducted in September 2011. The survey took place in a grain producing region in eastern San Luis Potosi. We collaborated with a local grain marketing cooperative for logistics and survey sampling support. In total, we interviewed 372 grain farmers that produce among corn, sorghum and soybeans, or a combination of them. Survey participants were compensated with $100 pesos for participating, which is about a day's wage.

The survey included demographic as well as production questions. We asked them about their current production decisions, land size, total assets and expectations about the next season. Specifically, we asked farmers to give an estimate on the lowest possible, most likely and highest possible crop price they expect to sell. They provided the same estimation for their crop yields: lowest possible, most likely and highest possible yields per hectare of the crops intended to plant, and in some cases for the rest of the crops. Once we gathered the price and yield data, we estimated their expected revenue for next season. That is, we estimated their minimum, most likely and highest possible revenue based on their price and yield estimations.

This same survey asked questions that define their credit rationing group. As mentioned before, this survey unambiguously categorizes each farmer, avoiding the use of instrumental variables to correct endogeneity. The flow chart of the survey is given in figure 5.8.

With the estimated revenue data, we calculated the first three moments of the distribution through simulation. Using the software @Risk, we inputted the minimum, most likely and maximum revenue values into a PERT distribution simulator. We ran

5,000 iterations for each farmer and from the resulting PERT distribution, we obtained the first three moments for each farmer. Those values were used in this analysis. Parameterizing a PERT distribution when data is limited to expert opinion is a common practice. The parameters needed to fit a PERT distribution are minimum, most likely and maximum. Another advantage of this distribution is that it allows for skewness.

A dichotomous variable was used as the dependent variable: 1 for risk rationed and 0 for price rationed. As regressors we used the estimated revenue variables for each of the three crops. If somebody planned to grow more than one crop, only the main crop in acreage was used for the analysis. For instance, if his main crop was corn, then the first three moments of corn would be used. We tested for differences in mean between groups for the estimated values of revenue and found them to be not significantly different. Because of this similarity, model [10] was used.

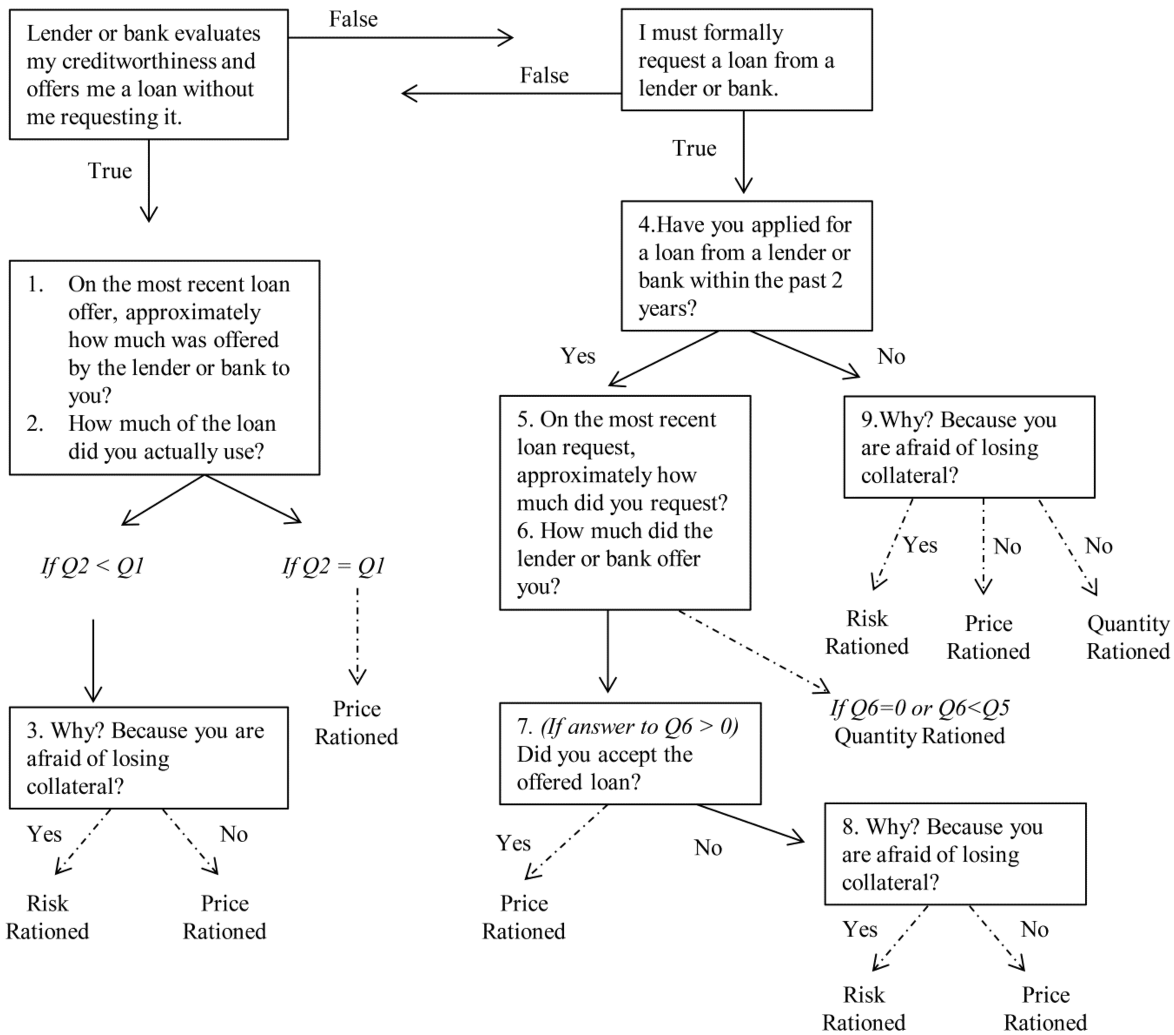


Figure 5.8.Schematic of the survey to classify producers according to their credit rationing.

Most of the farmers in this analysis have the intention of planting sorghum as their main crop for the next season, 53%; followed by soybeans, 24%; and corn, 23%.

The results of the regressions are shown in tables 1 and 2 for each crop.

The coefficients in the regressions represent the difference between the utility at initial wealth level, marginal utility of expected revenues, change in the marginal utility of expected revenues, and the third derivative of the utility function of expected revenues. Thus, a positive coefficient indicates that its value under risk rationing is larger than that under the price rationing state.

Table 5.1. Probit regression of expected revenue moments on risk rationed.

| **Risk Rationed = 1** | **Sorghum** | **Corn** | **Soybeans** |
|---|---|---|---|
| Mean | -0.0000303 | 0.000217* | 0.0000806 |
| | (0.669) | (0.019) | (0.392) |
| Variance | -7.38e-08 | -0.000000143* | -0.000000166 |
| | (0.211) | (0.014) | (0.071) |
| Skewness | 0.531 | 0.523 | 0.336 |
| | (0.279) | (0.406) | (0.563) |
| Constant | 0.246 | -1.011 | -0.865 |
| | (0.474) | (0.128) | (0.303) |
| Observations | 112 | 49 | 51 |

p-values in parentheses. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 5.2.Linear probability regression of expected revenue moments on risk rationed.

| **Risk Rationed = 1** | **Sorghum** | **Corn** | **Soybeans** |
|---|---|---|---|
| Mean | -0.0000173 | 0.0000743* | 0.0000227 |
| | (0.451) | (0.014) | (0.416) |
| Variance | -1.58e-08 | -4.85e-08** | -3.68e-08* |
| | (0.163) | (0.007) | (0.037) |
| Skewness | 0.170 | 0.159 | 0.101 |
| | (0.342) | (0.455) | (0.596) |
| Constant | 0.604*** | 0.155 | 0.178 |
| | (0.000) | (0.518) | (0.467) |
| Observations | 112 | 49 | 51 |

p-values in parentheses. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Equation [10] provides the interpretation of the coefficients. They measure the difference in utilities, and its derivatives, of the expected utility between risk rationed and price rationed. For each crop, the coefficient of the mean is $\beta_{\mu} = U'_R(\bar{y}) - U'_P(\bar{y})$; for the variance, $\beta_{\sigma^2} = \frac{1}{2}[U''_R(\bar{y}) - U''_P(\bar{y})]$; and for the skewness, $\beta_{m^3} = \frac{1}{6}[U'''_R(\bar{y}) - U'''_P(\bar{y})]$.The constant term measures the difference in utility at initial wealth level between a risk rationed and a price rationed. This random utility model measures the likelihood that a person would be risk rationed given changes in the moments of the expected revenue distribution.

Using the coefficients for sorghum under the linear probability model we have the following equation:

$$Prob(R = 1) = 0.604 - 0.0000173\mu - 0.0000000158\sigma^2 + 0.17\, Sk + e$$

[14]

We selected sorghum as an illustration since it is the crop that is most planted in our survey. Also, the coefficients of the linear probability model are used since they measure the marginal effects of the moments of the expected revenue distribution.

Looking at the results from equation [14], we find that the utility of risk rationed is larger than that of price rationed at the initial wealth level. This is given by the positive value of the constant coefficient. However, the negative coefficient of $\mu$shows that the expected marginal utility of revenue for price rationed is larger than the expected marginal utility of revenue for risk rationed. The larger the expected revenue for sorghum, the more likely someone would be price rationed. The sign of the coefficient for $\sigma^2$ is negative also, this means that the change in marginal utility of expected revenue for price rationed is lower than that of risk rationed. The larger the variance in expected returns, the more likely someone is price rationed, that is, risk rationed are more adverse to expected variance in returns than price rationed. The positive value of the coefficient of skewness indicates that the third derivative of the expected utility of revenue for risk rationed is larger than that of price rationed. This means that risk rationed people prefer more skewness of the expected revenue distribution than price rationed. Recall that by staying risk rationed, the skewness of their distribution becomes less negatively skewed relative to price rationed, indicating that price rationed respond less to skewness.

Similarly, corn and soybeans farmers have the same sign in the coefficients of variance, skewness and constant. They differ from sorghum growers in the sign of the expected revenue. Unlike sorghum, they have positive signs. This means that the larger the expected revenue for these two crops, the more likely a farmer would become risk rationed. Interestingly, not only do these results provide confirmative evidence of risk rationing but also evidence that the micro-structure of the farm itself and the dominance of one crop over another can influence risk rationing behavior.

The constant term has different signs for corn and soybeans growers in the two regressions. In the probit model (Table 5.1) corn and sorghum have negative coefficients, while in the linear probability model (Table 5.2) all crops have positive coefficients. Since the coefficient of the constant term indicates the difference in utilities at the initial wealth level between risk rationed and price rationed, a positive coefficient indicates that at the initial wealth level the utility of being risk rationed is larger than that of a price rationed. The signs of the coefficients for sorghum (the most common crop) in both models, and for the rest of the crops in the linear probability model, are all positive. This suggests that at the initial period, risk rationed have more utility than price rationed, and this may also indicate a preference for current consumption. When current utility is higher in risk rationed state, those farmers may not want to engage in the risky activity unless the utility derived from future revenues outweighs the utility at the present wealth level.

The results in both Tables 1 and 2 show similar results regarding coefficient signs except in the constant terms for corn and soybeans. The positive signs of the mean coefficients for corn and soybeans show that the marginal utility of the expected revenue is larger for risk rationed. This also shows a stronger preference for expected revenue than price rationed. It is worth clarifying that the positive value does not mean that price rationed do not prefer expected revenues. It is assumed that both groups do, but that the preference for expected revenue is stronger for risk rationed who planted corn and soybeans. Risk rationed who planted sorghum have a lower preference to expected revenues than price rationed.

On the results for variance, risk rationed people have a lower second derivative of expected utility of revenue than price rationed. This indicates that risk rationed are more adverse to higher values in variance than price rationed. They tolerate less variance than price rationed.

The results for skewness measure the difference in the third derivative between groups. Being positive for all crops, risk rationed seems to have a stronger, or at least not weaker, preference for skewness of the expected revenue distribution. This is an important result that tests the theory of the jump disutility for risk rationed. The jump disutility decreases skewness in the revenue distribution, which occurs when borrowing formally. Risks rationed are more sensitive to changes in skewness, which is why they refrain from borrowing when this change is sufficiently large.

These results test the hypothesis that risk rationing is the result of a jump disutility of a borrower. This jump creates a probability shift towards the left of the distribution which in turn increases downside risk. When the jump disutility is large enough, farmers would restrain from borrowing in order to avoid falling below the threshold that triggers the jump.

The positive coefficient for skewness indicates a preference for probability of large gains as well as the minimization of losses. In the data, we find evidence that the risk rationed are more downside risk averse than those who are price rationed since most farmers who do not use fertilizers are risk rationed. This occurs despite the higher increase in yields and revenue per hectare from utilizing fertilizers. These farmers are giving up the possibility of higher income by limiting the loss in case of disaster. Limiting downside risk becomes a dominant factor for input use.

Finally, following our model, the coefficient captures the effect of the differences of utility at the initial wealth. The sign of the coefficients tell us the difference in utility of initial wealth for the two credit rationed groups. All of the three crops have positive coefficient. This means that the utility at the initial state of wealth is larger for the risk rationed group for all crops. This may also be a reflection of being risk rationed, since they are better off at the initial state than price rationed; consequently, it is more difficult for them to want to move from that initial state. By preferring the status quo, they have more at stake when borrowing formally because that status quo is jeopardized.

The difference in utility at the initial wealth level, given by the constant term, measures the preference for current consumption. In this case, risk rationed farmers have a stronger preference for current consumption, suggesting that their discount rate for future consumption is higher than that of price rationed.

Since risk rationing farmers do not borrow formally, by definition, they rely on informal borrowing or own saving to smooth consumption. Following Morduch's empirical tests for complete markets we regress household expenses on informal loan as a proxy for transitory income and savings. Informal loan is negative and marginally significant (p= 0.18), and saving positive and significant (p= 0.0). These results suggest that farmers use these mechanisms to smooth consumption, and thus implying that credit markets are not complete.

Income smoothing mechanisms for risk rationed are also observed in our study. Our data shows that risk rationing farmers are much less likely to grow a high revenue- high risk crop in favor of low revenue-low risk ones. For instance, the percentage of risk rationed farmers who grow corn or sorghum, deemed as less risky crops, are about the same as price rationed farmers; however, the ration of price rationed farmers who grow soybeans, the high revenue crop, is more than double than that of risk rationed, 67 and 33%.

***Conclusion***

This paper explores an alternative view to understand risk rationing among farmers in the context of a developing country. This new approach is formulated from Mason's disutility jump. The  implications of the jump is a preference for skewness, which implies  significant downside risk aversion. In this paper we estimated each farmer's expected revenue distribution by simulating a PERT distribution using three parameters obtained from a survey conducted in rural Mexico. Using the resulting simulated (PERT) distribution's moments (mean, variance, skewness) we performed a random utility analysis between people classified as risk rationed and price rationed. we find that risk rationing preference depends on expected distribution, skewness preference and discount rate.

Following the jump disutility theory proposed by Masson, we created a model where this jump disutility refers to the collateral loss that risks rationed avoid by not entering into the formal credit market. From there we have two possible distributions of future revenue, one under debt and one without debt. A formal debt would create, or increase, a disutility jump at a given revenue threshold, which if reached, triggers the jump disutility in the form of collateral loss. Reaching the threshold level of revenue is avoided at all costs under risk rationing. On the other hand, the distribution of future revenues without debt does not have this significant disutility jump, thereby, making that distribution less negatively skewed compared to being risk rationed. We find that risk rationed have a stronger preference for skewness and their expected revenue distribution is less positively skewed, or more negatively skewed, than that of price rationed.

Through a random utility model analysis, we estimate the preferences for expected revenue moments, and for present consumption. By looking at the differences in utilities and their derivatives between credit groups, given by the coefficients of the random utility model, we estimate that risk rationed have a higher discount factor than price rationed. This suggests that risk rationing can also be explained by the preference of current consumption. Price rationed, on the other hand, sacrifices current consumption in hopes to have a larger future consumption. This is measured by the difference between utility at initial wealth level. This difference is the constant term in the regressions.

The results in this paper test the hypothesis that risk rationed farmers face a jump disutility in case they borrow formally. This jump is trigger by revenues falling below a threshold level. The consequence of the jump disutility model is that risk rationed farmers would not prefer less skewness in their expected revenue distribution than price rationed. This is tested empirically for all crops by looking at the skewness coefficients of the random utility model. A positive value indicates that risk rationed prefer more skewness in the distribution; however, although the significance level of these coefficients indicate that they are not statistically different from zero, they suggest that risk rationed do not have less skewness preference than price rationed, supporting utility jump theory. Another result consistent with the theory is that risk rationed farmers have larger aversion, or at least are not less risk averse, to expected variance of revenues.

Although we believe that the analysis of risk rationing through the use of a random utility model shed lights on time preference of consumption, skewness preference, and degree of risk aversion and downside risk aversion, other approaches to understanding risk rationing can be explored. One approach would be the application of behavioral and psychological models of risk, perhaps through experimental mechanisms. Farmers' response to the risk of losing collateral by not borrowing needs to be examined through the interaction of emotions and calculative probabilities of default. This is a natural extension of this topic that can provide further insights on the relationship between risk preferences and emotions.

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CHAPTER 6

# PERCEPTION AND ACTION IN A CONFLICT ZONE: A STUDY OF RURAL ECONOMY AND RURAL LIFE AMIDST NARCOS IN EASTERN SAN LUIS POTOSI, MEXICO.

***Abstract***

The purpose of this paper is to analyze the relationship between psychometric measures of risk perception and socioeconomic variables of small farmers living in a drug conflict zone in Mexico. The analysis follows two models of behavior and stimuli perception: The Ecological Psychology model, and the Dual Process Model. Using psychometric measures of risk we classified farmers into four groups, depending on their level of fear, familiarity with the risk of narco violence, and trust to authorities among other factors. For each of the four groups created we ran a multivariate regression on demographic, social and economic variables. In accordance to the literature, we find significant factors that determine group classification and others that provide new insights into violence perception and fear. Next, we used each of the groups as explanatory variables for determining stated changes in behavior due to violence. To our knowledge, this is the first study on small farmers' risk perception and action in real time conflict areas, more specifically in the drug conflict areas in Mexico. Our results show that the current war on drugs in Mexico is not only affecting the urban population as it is widely perceived, but it is also affecting low income

farmers. The increase in risk perception due to criminal activity also has an effect on their risk taking behavior and adoption of new production technology. Our results can help determine a strategy to ameliorate those risks perceptions and improve rural life.

***Introduction***

The level of violence in Mexico caused by the ongoing war on drugs has escalated dramatically in scale and scope affecting all members of Mexican society in many parts of the country. Based on official data from several government agencies, from December of 2006, when then newly elected president Felipe Calderon declared the war on drugs, to May of 2012, the newspaper Zeta estimates the number of homicides related to the drug war at over 50,000 (Proceso, May 28, 2012). Although most of these casualties are believed to be members of the drug cartels and government forces, many victims have been civilians unrelated to any side of the conflict. For instance, one of the most violent cases of attacks to innocent civilians is the arson of a casino in the city of Monterrey in August 2011, resulting in the dead of 53 people. This attack was perpetrated by a drug cartel when the casino refused to make extortion payments (Excelsior, August 26, 2011).

The risks derived from the drug war that affects many civilians are kidnapping, extortion and carjacking. According to the Sistema Nacional de Seguridad Publica (2011) (National System of Public Safety), the official number of kidnaps in 2006 was 80% higher than the previous year. This number rose by 27% in 2007. The same agency reported the official number of extortions in 2007 to be 3,123.

Kidnapping and extortion, along with homicide, are also called high-impact crimes for the lacerating effect that they have on society. Being exposed to these kinds of traumatic events, including disasters and acts of terrorism, create cognitive, emotional and social effects on the victims (Alexander D., Klein S., 2009). Some of these effects range from sleep disturbances, worry, and irritability to severe ones like psychic numbing, and recurring thoughts about the stressor (T. Markesteyn, 1992).

As dramatic as these events are, we are unaware of any studies that have investigated how narco violence impact the human psyche, the changes in risk perception, or how it affects life in general. More specific to this paper is the effect of narco violence on agricultural productivity and rural life. By rural life we are interested not only in action but also in perception, with the latter occurring at the emotional level.

The purpose of this paper is to analyze the relationship between psychometric measures of risk perception and socioeconomic variables of small farmers living in a drug conflict zone in Mexico. Using psychometric measures of risk developed by Slovic (1987), we classified farmers into four groups, depending on their level of fear, familiarity with the risk of narco violence, and trust to authorities among other factors. For each of the four groups created we ran a multivariate regression on demographic, social and economic variables. In accordance to the literature, we find significant factors that determine group classification. Next, we used each of the groups as explanatory variables for determining stated changes in behavior due to violence. To our knowledge, this is the first study on small farmers' risk perception and action in real time conflict areas, more specifically in the drug conflict areas in Mexico. Our results show that the current war on drugs in Mexico is not only affecting the urban population as it is widely perceived, but it is also affecting low income farmers. The increase in risk perception due to criminal activity also has an effect on their risk taking behavior and adoption of new production technology. Our results can help determine a strategy to ameliorate those risks perceptions and improve rural life.

We measure degrees of affect (a feeling of good and bad), as defined by Slovic et al. (2007), of small farmers in a conflict zone. Specifically, we look in the emotions of farmers caused by the actions of drug cartel members (narcos). Our area of study is located in a tri-state region in northeast Mexico where for the past years the level of drug related violence has been overwhelming. In this area local police have been supported by convoyed federal forces. In some cases, local police have been investigated on corruption and complicity with the drug cartels. There have been cases where local police forces are dismantled completely if enough evidence of complicity is found. When this happens, military forces take over their duty of patrolling and enforcing security. The cities of Tampico and Veracruz are cases where the military are in charge of the local security (Proceso, April 19, 2012).

To investigate narco violence on economics and rural life we need to step back from traditional economic paradigms to gain an understanding of behavior itself. Thus, our study is more tied to psychology than economics and in doing so we make some observations about behavior that are satisfying to both camps.

In the psychological realm the problem posed is to know from which areas of psychology do we investigate. Two become clearly relevant, and we tie them together in a way which we have not previously seen done. The first is from the point of view of ecological psychology. Ecological psychology evolved principally from Gibson (1986) about how organisms relate to their environment. The domain of his research in ecological psychology has not at all been in the social domain, as is our interest in this paper, but the physical domain (P. Kugler, M.T. Turvey (1987); M.T. Turvey (2009); R. Shaw (2003)). The second strand views people's decision making as the interaction of two systems: the emotional and the analytical. This method of understanding decisions is called Dual Process. Under this paradigm, people's decisions are affected by their fear level, or the emotions invoked from an event; and also by their objective assessment of the probability of an event, a rational mechanism. This part of social psychology follows Slovic (2002, 2004); Slovic, Lichtenstein, and Fischhoff (1984); Finucane and Holup (2006); Loewenstein, G., & O'Donoghue, T. (2005); Mukherjee K. (2010); Schulze W, & Wansink B. (2012).

The two areas are different in several ways. Risk perceptions are for the most part non evolving, static events, where the ecological approach is dynamical. This does not mean that in terms of the researchers' toolkit the two strands of psychology should not be viewed as being mutually exclusive, but simply needs to be looked at through a different lens to see the connection. We argue that the Dual Process theory can complement the ecological psychology model, and to an extent we can say that the Dual Process is contained in the ecological psychology framework.

### ***Background and Literature Review***

Slovic (1987) provides an axiomatic system to determine risk perception using a set of questions that measures characteristics of risk. Some of these characteristics are magnitude of risk, control over the event, familiarity and knowledge of the event, and lasting effects of the event. He synthesizes those results into a two-factor space: familiarity with the event, and dread level. Depending on where in that space an event is located, its social consequences can be predicted. A large accident that occurs in a familiar setting has a much smaller social impact than a small accident in an unfamiliar setting. Car accidents for instance, which kills many people per year and is consider by experts to be one of the activities with highest risk, has a much smaller social impact than nuclear reactors even though the number of deaths from them are negligible compared to car accidents. This is due from the perceived potential of catastrophe and the unfamiliarity of the event. While we can assess risk objectively as a probability of an event, when we evaluate that probability based on feelings, it tends to be exaggerated if the event being analyzed is frightening (Rottenstreich and Hsee, 2001).

Although the tools developed by Slovic are very important in understanding how information and feeling of control about an event affect our risk perception of it, it does not suffice to explain the dynamics of risk perception, specifically for people living in a conflict zone as is the case in this study. Our belief is that viewing conflict through the prism of risk perceptions alone is inadequate since it excludes action. Action of some form, a response sort to speak, is critical. Two psychological approaches that incorporate actions in risk perceptions are the ecological psychology model, and the Dual Process model.

### *Ecological Psychology and Dual Process Theory*

From the Ecological Psychology perspective, the way we perceive risk depends among other things in how we identify key variables that specifies the event, and in our environment. Our actions and intentions depend on our perception of the world; this perception is determined by how we process information about various events, which in turn depends in our environment. However, our actions affect the way we process information therefore creating a circular relationship (Michaels C., Beek P. 1995). In other words, our actions are endogenous to our perception of risk.

Borrowing figure 6.1 from Michaels and Beek (1995), we modify the labels of each box to represent the factors of the perception-action cycle for the farmers of our study.

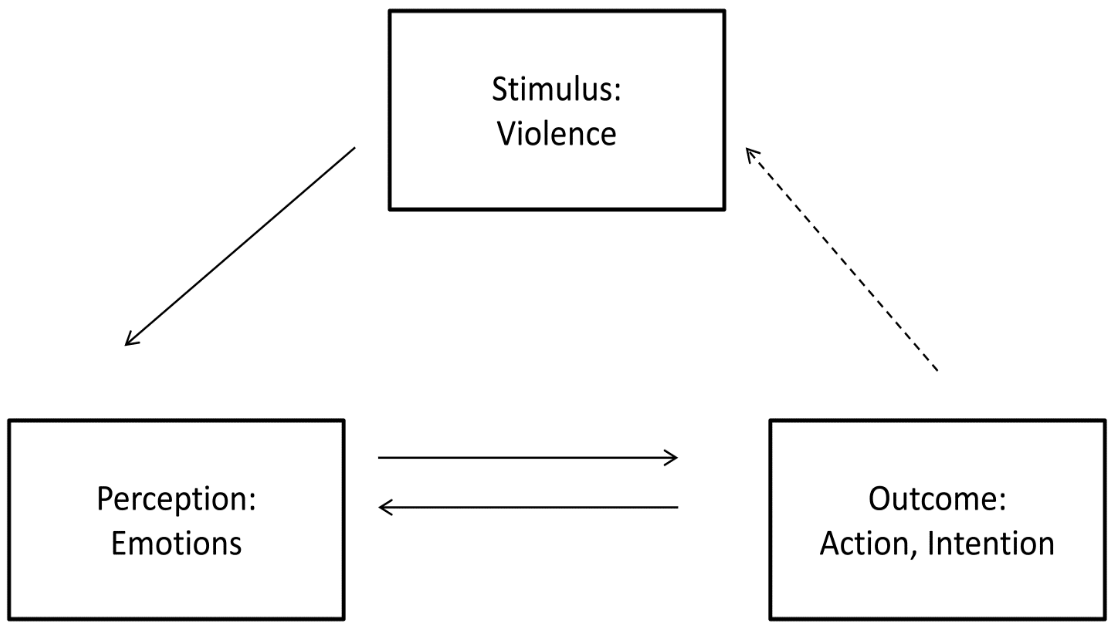


Figure 6.1.Relationship of stimulus, perception and action under the ecological framework.

Here the stimuli are the violence from narcos in the community, which is the environment from the ecological perspective. The stimuli are perceived by the farmers differently, depending on several factors including demographic variables. How we perceive fear is analyzed using Slovic's methodology. Given some stimuli and how we respond to them is time definite in the Slovic framework, our decisions have no impact on our perception.  From the ecological view, our perception of the stimuli (violence) would make us act in a certain way or create new intentions regarding them. These actions and intentions create a feedback and can alter our perception of the stimuli as well; therefore, making this interaction dynamic. This is the circular relationship between our action/intentions and our perception (Michaels and Beek).

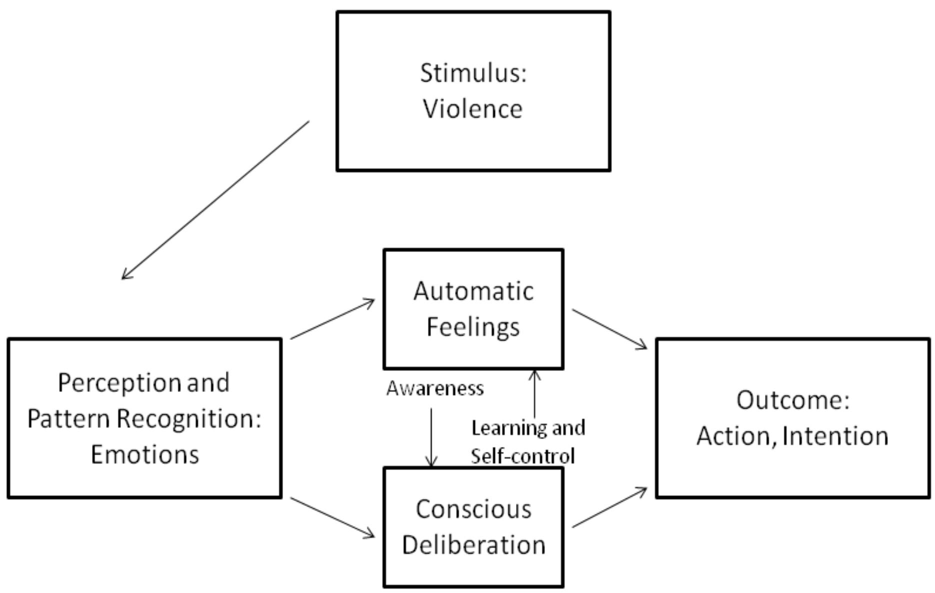


Figure 6.2.Relationship of stimulus, perception and action under the dual process framework.

The mechanism in which the dual process model works is explained in the following lines. An individual makes his decision based on a combination of two factors: emotional and rational. The emotional system of decision is also known as system 1, and the rational system as system 2 (Kahneman, 2011). This utility function is comprised of a linear combination of utilities of these two components. In the rational component, probabilities are assessed for each state of the world and multiplied by the utility of each state based on some attributes. The sum of these probability-weighted utilities is the total utility from the rational component. In the emotional side, each state is assigned a utility based on the difference of attributes from a reference point, or status quo. That is, the utility derived from the emotional component is based on how different is each state in relation to a reference. There are no probabilities assigned at each state in the emotional component. Once the individual assess his utilities from the two components, his final utility is a linear combination of them. This allows for final utilities based only on emotional component, rational component or both[5].

The dynamical structure of the ecological approach is a much richer, with stimuli leading to risk perceptions, risk perceptions leading to action, and action feeding back in to stimuli to diminish or exacerbate, and so on. The structure of the dual process theory, on the other hand, relies on two decision making mechanisms in the brain: an automatic response mechanism based on emotions, and a conscious deliberation mechanism based on rational choice. The way in which stimuli is perceived is similar to the ecological model. Here stimuli lead to pattern recognition (risk perception); pattern recognition is analyzed under the two mechanisms, emotional and analytical; and then a decision is made. While the duel process model is by itself a very used model in behavioral economics, it is contained in the ecological model (see figure 6.2). Therefore, for the rest of this paper we will focus on the

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[5] According to Shulze and Wansink (2012), an individual maximizes the following dual process utility function: $(1-\gamma)\sum_s P_s(\ldots, a_{iks}, \ldots)U_s(\ldots, a_{iks}, \ldots) + {}^{\gamma}/_{n}\sum_s M(\ldots, a_{iks} - a_i^0, \ldots)$, “where $a_{iks}$ is the level of attribute $i$ for choice $k$ in state $s = 1, \ldots, n$; $a_i^0$ is the status quo or reference point for attribute $i$; $\gamma$ is the relative weight on emotional utility…”

ecological psychology approach to behavior, under the premise that by analyzing behavior with this approach, the dual theory approach also holds for the analysis. This will be demonstrated later in the paper. We believe that two decision theories used in this study, fear perception based on Slovic's methodology and the ecological approach, are congruent and our research design was developed around this congruency as artifact and hypothesis. We have found no research within the psychological and economic literature that has laid these two approaches together, along with the dual process model, as we do in this study.

What then are the conditions for a system to be part of the Ecological Psychology framework? Petrusz and M. T. Turvey (2010) cite four features for this: 1) They (animate beings must) reside at the ecological scale of organisms and environment; 2) the scale of perception-action, not at the scales of their components; they connect closely to the formalism of affordances; 3) they are more general than, not special cases of, the laws of physical (inanimate) systems; 4) they make reference to themselves, their form is impredicative.

What do these conditions mean and how they relate to the language of economics is explained next. Condition 1 is an existence proposition, that is, animate beings must be in an environment. Since the environment refers to the surroundings, wherever there is an animate being, there is an environment. This condition holds as long as there exists an animate being, something that by definition exists in every economic system. In Mexico the infiltration of rural areas and the widespread exposure to terrorism and conflict satisfies the condition of a dynamical environmental system between, in our case, farmers and directly or indirectly, the narcos. Condition 2 states that perception and actions depend on affordances. The term affordances have evolved since its early usages in 1977, from the definition of an affordance of something as the "properties of its substance and its surfaces taken with reference to an animal" (Gibson, 1977), to the opportunity for actions in an environment (Schmidt, 2007). An inanimate object, for instance a table, affords placing objects on top of it; in the same manner a stairway affords climbing it. Objects also have intangible affordances that may be specific to each individual. Schmidt (2007) provides an example of stairs as affording the feeling of "warm greeting on holidays.", or the affordance of a "cup being a gift." Under this context, an object, or environment, affordances are not only the opportunities for action that it provides for individuals (animals), which may be similar under the same social context (e.g. sharing the same culture or education); but also affordances describes the feelings caused to a person (animal), which again depends on individuals experience with an object/environment. People affordances refer to the opportunities of actions he provides, thus a person's affordances are related to their personality, physical and mental capacity. A person's affordances are his "dispositional properties that would affect a given action". Examples of person's affordances are given by Gunns, Johnson, and Hudson (2002) as the perception of vulnerability people give to others; and by Richardson, Marsh and Baron (in press) as the ability or disposition to help others. In the first example, people may increase their chance of being victimized; in the second, it can affect others' feeling of safety, and thus alter their behavior (moral risk). People affordances can differ from the individual to the group level. Cooperation among people can enhance their individual affordances and affect the affordances of objects/environment, like the change in “edibility affordances of larger animals” (Baron, 2007) when attacked by a pack of wolves than by one. Similarly for humans, vulnerable individuals can join forces in a group in order to protect themselves. Personal affordances, together with the affordances from the environment provide a “social context” for actions (Lockman and Hazen, 1989). In the current paper, in which we study farmer responses to narco terrorism, it is the narcos that affords fear to our sample base. The existence of the narcos, is as unique to their environment, as a table is to writing. The idea is that the affordances including fear, risk perceptions, actions, responses and so on are as much a part of rural life in Mexico in the presence of Narcos, as happiness, comfort, tranquility are affordances to rural life in their absence.

For economists, the concept of affordance relates to those variables from the environment or from within the individual that affects his behavior. Affordances under the economic context can be exogenous, like age, marital status, income, and violence level; or endogenously determined by other variables like production, demand, fear. Within each group, we have personal (age, marital status, fear) and environmental (crop production, violence level) affordances. Instances of group affordances are belonging to a credit union or farming co-op.

Condition 3 refers to the physical properties of the entities in the ecological system. Although governed by physical laws, affordances are determined by the relevance to the animate beings. That is, even if an object has certain physical characteristics that provide various affordances, more non-physical affordances can exist. For instance, a mirror’s reflectivity, an affordance, can be explained by laws of physics; but the appeal and usefulness of a mirror is meaningful to an animate being

(Petrusz and M. T. Turvey, 2010) but not of much use to an inanimate object. In economic terms, this third condition makes allowances for ordinal transformations of the physical attributes of goods to measures of utility. Thus price affords utility, or product characteristics afford utility. In the Mexican situation one can consider affordances in degrees. For example, observing a Narcos in a truck provides different affordances than a narcos with a gun, which provides different affordances when the narcos shoots the gun. In each case the physical system is altered in one way or another and the emotional affect on the recipient will (may) too be impacted. On the other hand, like the mirror with no user, opaque narcos activities that are meaningless to the farmer may provide no affordances at all.

Condition 4 refers to the self-awareness of the animate beings in the environment, that is, they are impredicative. Affordances of the environment involve the individuals to be aware they are in the environment. Petrusz and M. T. Turvey (2010) exemplify impredicativeness in a situation when we want to say who is the tallest person in a room, we need to include ourselves in that comparison. For the affordance "X is the tallest person in the room" to be true, we need to be compared as well as everyone else. Each individual is "both a perceiver and object of perception." In the economic system, each individual knows that he is an active part of the system. By being in an economic system, he interacts with others who perceive his affordances to them. In some situations (as in game theory) he has to predict what others will do based on others' anticipation of his actions. To the economist, impredicativeness refers to endogenous relationships that may or may not be directly observed. For example, if we consider the relationship between stimuli and perception the linkage is well defined by the affordances from the Narcos as the affect the perceptions or risk on the farmer. The farmer acts on these perceptions and to a large extent these might be observable. i.e. the farmer moves away; the farmer resists, the farmer changes crops to reduce exposure to criminals and so on. These actions, no matter how subtle, thus establish a new set of affordances, but now from the farmers to the Narcos. The truly endogenous relationship is that which relates action to stimuli and this is where the idea of impredicativeness becomes necessary rather than sufficient. If there is no relationship between action and stimulus- no feedback rule, or hysteresis or path dependency, there is no impredicative state and the system according to Turvey is not an ecological system. Instead, according to our figure 6.2 , the system reduces to a dual process system, which to our knowledge has never been characterized as an ecological system. An ecological system can involve a dual process system, but this does not mean that a dual process system is ecological.

We believe that our study meets the aforementioned criteria. However, the fourth condition needs to be tested. It is explained later in this paper the methods used to test for impredicative in the system, which is the feedback between stimuli and actions. That is, that those variables are endogenously determined within the system. In the context of ecological psychology, impredicativeness corresponds to the feedback between outcome and perception (figure 6.1). In the context of this study, this is translated as the feedback between actions of farmers and their perceptions of fear. This feedback occurs if the covariance matrix of the error terms between actions and perceptions is non-diagonal, i.e. if there is correlation between these variables. This feedback can be tested by means of a Hausman test for endogeneity. Moreover, the concept of affordances, the second criteria, in our study corresponds to variables that are exogenously determined, i.e. independent. Examples of these are demographic variables and other risk perception variables. Unlike impredicativeness, affordances need not be tested since they do not refer to relationships between variables, but as how they are specified (exogenous instead of endogenous).

***Fear Perception and Individual Characteristics***

Fear perception depends on individual characteristics as well. Studies show some demographic characteristics that affect the perception of risk, specifically, that women are more likely to show higher level of fear than men, even though men have a higher probability of victimization (Bennett and Flavin, 1994). This is attributable to the position of women in society and to physical differences in gender. The relationship between age and crime are mixed. Bennett and Flavin (1994) show a positive relationship; while Kanan and Pruitt (2002) shows that older people are less fearful than younger ones. Borooah and Carcach (1997) analyze the effect on education and fear level and find that more educated people are less fearful than less the less educated. In a study on fear of crime, Reese (2009) found that the proportion of fearful people in different countries when the crime rate is high turns out to be low, and vice versa, when the crime rate is low, the proportion of fearful people increases.

Feeling of control over risks changes our perception of them. People's response to fear is associated to the level of control they have on the event, and are willing to take a higher risk in a controllable event than in another one where they have no control on the outcome (Slovic, 1987). For instance, driving a car and riding an airplane. Jackson (2012) states that higher perceived control is associated with low perceived risk.

Beliefs also play a role in people's emotions, and through emotional influence beliefs can be distorted. Attacking or questioning one's core beliefs creates an emotional response. Thus, people with same but false beliefs tend to support each other. At the same time, belief distortion can happen when the subject is under stress (Sjoberg, 1979). Distorted beliefs occur also when subjects are doing probabilistic inferences (Kahneman and Tversky, 1972). They accept the sample as representative of the population as long as it conforms to what subjects believe the population ought to be. That is, they trust a small sample size more compared to a larger one.

The number of sources of information exposed also affects risk perception. In a study in Finland on how exposure to crime news affects risk perception, Smolej and Kivivouri (2006) find that the more exposed to crime news somebody is, their fear of violence increases. Again, people's perception on crime is exacerbated by the images, and not analyzed rationally. According to Eschholz et al. (2003), the substitution hypothesis states that the less is the personal experience with crime, the larger is the level of fear derived from crime media exposure. However, the resonance hypothesis, an opposing idea to the substitution hypothesis, states that those individuals who have experience crime are more prone to have higher fear levels when exposed to crime media (Rountree and Land, 1996). Another hypothesis on the effects of crime media on fear level states that the groups of people that feel more vulnerable are the most affected by crime news (Liska and Baccaglini, 1990). In other words, the more likely someone feel to be victimized the higher level of fear they have by being exposed to crime news.

Responses to risk perception take many forms, from physiological reactions such as irritability, anxiety and sleep problems (Kazantis N., 2009), to behavioral, like avoiding stressful situations, actions or objects deemed risky. Consumer reaction to an increase in risk perception of food products is analyzed by C. G. Turvey, et el. (2009) in a national survey about food safety regarding the first Mad Cow case in the U.S. They find that some of the factors that affect beef consumption in the U.S., although in a small degree, are voluntariness, control, dread and knowledge. C. G. Turvey reports that in general consumers do not perceive the risk as high, and only 15% of them indicate a decrease in consumption. However, this drop in consumption lasted about six months. The high level of trust from consumers to farmers, government and food processors and retailers is attributable for this low effect on risk perception and decrease in consumption. In a latter paper, C. G. Turvey et al. (2010) examines the relationship between risk perception and the economic consequences of a biosecurity threat in the U.S. food system. Using cluster analysis and dividing consumers into three groups: optimist, cautious and fearful, they find that fearful consumers reduce their food purchases more than the optimist. Time taken before consumption is resumed increases with the level of fear, showing hysteresis in fear perception.

From the producer side, Rockmore (2011) studies farmers' behavior in post-conflict areas in northern Uganda. Using a national household data set, he shows that farmers switch production to lower expected return activities; thereby, lowering per capita household expenditure by up to 6 percent.  In this study, risk accounts for more economic losses than direct exposure to violence.

The study presented in this paper is conducted in a conflict area in Mexico where drug related violence is a recent phenomenon. High violence level due to the drug war started in 2006, and since then it has spread in many parts of the country. Although some areas are safe from the violence, the estimated percentage of families with more than one victim of crime in Mexico is 14% in 2009, while in Mexico City that number is as high as 28% (ICESI, 2009). The official number of kidnappings in Mexico rose from 595 in 2006 to 1,220 in 2010; however, it is estimated that about 20% of victims report the crime to authorities.

Fear of crime affect daily urban behavior even in those who are not victims of crime. In national surveys done by the ICESI, in 2009 22% reported that crime has affected their quality of life, up from 14% in 2008. Most of the changes in behavior reported by the survey are that people stopped using jewelry, didn't allow their children to go out of home, didn't go out at night and stop carrying cash (ICESI, 2009).

The level of violence in the area of study has increased substantially in recent years. Near our area of study, in the limits between Tamaulipas and Veracruz States, the violence between two rival cartels reached new levels as 10 decapitated bodies where left on a road; two days later 13 more bodies appeared again (Proceso, December 31, 2012). Large number of families from nearby Tampico and other medium sized cities has migrated to cities safe from drug related crime (kidnapping, extortion), and many more have migrated to the south part of Texas. This kind of migration is done by higher income families benefiting greatly the host cities (Durin, 2012) at the cost of reducing economic activity in the hometowns.

***Methodology***

The methodology used in this study is based in a survey previously mentioned in Chapter 2. I will discuss it again for clarity in the context of this study. Between September 13th and 26th of 2011 we interviewed 370 small farmers in the eastern part of the state of San Luis Potosi (SLP), in a region of about 600 $Km^2$ near the border with the states of Veracruz and Tamaulipas. The population of the counties of Ebano and Tamuin, where our survey was conducted is about 41,000 and 38,000 respectively (INEGI). We sampled from 5 different rural population centers near the city of Ebano, SLP. In each population center we interview people from different ejidos, or communes. The population centers differ in size, being the largest one about 6,000 people and the smallest one about 3,000. A marketing cooperative in Ebano called Interagro de las Huastecas, S.A. de C.V. provided much of the logistic support for our research. They helped us in selecting a representative sample from all the communities in the region and establish a daily route. We hired eight local college students as enumerators for the survey, and train them by pilot testing the survey in our first day of fieldwork; however, we didn't include those surveys in our results.

Every day we would visit one community, and in the case of the larger communities we would repeat the visit at most four times. The way we recruited the participants for the survey was either talking to different ejidos' leaders and let them spread the news, or through loudspeakers announcing the request of farmers to participate in a survey for a university. Announcing daily events through loudspeakers is a common practice used in all the communities we visited and in many rural communities in Mexico. Also, much of the information is transmitted through word of mouth. Ejido's leaders are in charge or passing the information to its members. In the communities there are no phone lines, although many have cellular phones, and the mail service is not used as a communication device. The methods we employed to reach to people are the ones they are familiar with. For completing the survey we offered $100 pesos to participants, which is equivalent to more than an average day's wage.

We acknowledge the selection bias that both recruiting methods may have; however, we made every effort to correct for it. For instance, we sampled from different areas of the communities, and tried to include farmers from all ejidos. We knew from the local marketing association the total number of farmers in the region belonging to ejidos, the number of ejidos and the size of each population center. Based on this information, we selected our communities and ejidos as to have a balanced sample.

The survey was roughly divided into two parts: the first part asked about basic demographic and economic questions and the second part were question regarding their perception on insecurity and fear from the drug violence. The survey consisted of 162 questions that took on average 45 minutes to complete. The questions were read and the answers written by the enumerators in order to eliminate any ambiguity. Although participants were told that they do not need to answer any question that they consider inappropriate, all of them answered every question.

Since most of the farmers interviewed belong to an ejido, they all have roughly the same amount of land, 10 Ha. The age ranged from 18 to 87, being 18 the legal age in Mexico. 75% are married, and only 8% single, but 92% have children. 86% of the respondents were male and 14% female. Most of their economic activity is planting sorghum, corn or soybeans. Almost every respondent is aware of the government's war on drugs, 85% responded that they are aware of it, 7% said no and 8% were not sure about it. When asked to rate the change in crime in their community from the previous year, 62% said that the crime has increased.

### *Cluster Variables Explained*

We want to evaluate the perception of fear given demographic characteristics as well as the resulting actions and intentions in response to risk. Given the multidimensionality of Slovic's psychometric measure of risk, we opt to do a two-step cluster analysis to provide a natural grouping according to the multiple factors of risk using SPSS. For the creation of clusters, we used a set of 17 questions derived from Slovic but adapted to the local environment; they were answered using a five-point Linkert scale. These questions reveal the degree of dread people have given various situations, they also measure the degree of familiarity to the risk, control over the risk, magnitude and length of the disaster.

The clusters and their defining variables are shown in table 6.1. The main characteristics of each cluster are the following; Group 1 shows to have no control in case the risk is present, but feels is preventable, is unfamiliar to the risk, doesn't trusts authorities, doesn't feel personally at risk, but feels the risk is catastrophic but short lived; Group 2 feels in control in case risk is present, can prevent the risk, doesn't feel the risk is catastrophic, is unfamiliar to the risk, and doesn't feel personally at risk; Group 3 has the highest level of fear, doesn't trust authorities, is unfamiliar to the risk, feels the risk is increasing catastrophic and cannot be controlled; Group 4 feels personally at risk, doesn't feel it is catastrophic but feels it can last a long time, lacks risk prevention, but feels it can be controlled once the risk is present, and trusts authorities.

We label Group 1 as *cautious*, Group 2 as *confident*, Group 3 as *fearful*, and Group 4 as *optimistic*. The values in Table 1 are the OLS regression coefficients along with their p-value. The significance level at .15, .10 and .05 are denoted by one, two and three stars respectively. The *cautious* group for instance, has a significant positive value to the statement "Random shooting can kill many people" meaning that they strongly believe the statement; *Confident*, on the other hand, are unlikely to feel this way. *Optimistic* also feels that a catastrophic event is unlikely. *Fearful* are more likely to respond positive to the statement "If stopped by narcos, I'll die", and to "The risk of getting kidnap / robbed is increasing". Similarly, confident and fearful respond negative to the statement that "risk of getting robbed can be reduced". *Confident* are likely to feel that the risk of getting kidnapped or robbed is decreasing but they also feel that they cannot do anything to reduce that risk.

Group 1 is the largest of the clusters with 111 members (30%), followed by group 4 with 100 (27%), group 3 with 83 (22%), and finally group 2 with 76 elements (21%) from a total of 370 observations.

In our survey, apart from the questions that designate each of the four clusters, we also have questions that elucidate people's perception about crime in their community and roads, that estimate the likelihood of being victimized, and questions that elucidate their level of fear of being victimized by different crimes. Since these questions require answers for several related parts, and to simplify the information that these questions provide, we created three clusters for each of them. That is, we have three clusters that describe the following: violence level, probability of being victimized in the next 12 months, and fear of being victimized in the next 12 months. The values of these clusters represent the value of each variable: 1 being low value, 2 middle, and 3 high value.  The resulting clusters are named: FearLevel, ViolenceLevel, and ProbCrime. Each of these names is followed by the suffixes G1, G2 and G3 that indicates the value being low, middle, and high. Therefore, the variable FearLevelG1 is the group that has the lowest fear of being victimized in the next 12 months, and FearLevelG3 has the highest fear. These questions are also on a five-level Linkert scale. An example of a ProbCrime question is the following: Do you feel that you or your family can be victim of the following crimes in the next twelve months? Respondents have to answer for each of six different crimes (carjack, theft, extortion, kidnap, homicide, assault) their likelihood ranging from 1 to 5: from not likely at all, to extremely likely. FearCrime questions are of the same nature. How much do you dread being a victim of the following crimes in the next twelve months? is an example of FearCrime questions. Again, respondents are asked to answer their fear of crime for the six crimes mentioned earlier in the same Likert scale.

Table 6.1. Regression of groups on their determining variables.

| | Group1 | p | Group2 | p | Group3 | p | Group4 | p |
|---|---|---|---|---|---|---|---|---|
| If stopped by narcos, I'll die | -0.0114 | (0.460) | -0.0296*** | (0.021) | 0.0303*** | (0.003) | 0.0106 | (0.358) |
| I prevent being killed by narcos | -0.00122 | (0.925) | 0.0305*** | (0.005) | -0.00754 | (0.385) | -0.0217*** | (0.028) |
| If extorted, can sell assets and leave | -0.0301*** | (0.017) | 0.0163* | (0.117) | -0.0119 | (0.153) | 0.0257*** | (0.007) |
| Random shooting can kill many people | 0.107*** | (0.004) | -0.0592** | (0.055) | 0.00978 | (0.691) | -0.0571*** | (0.041) |
| Living under violence is new to me | -0.0852*** | (0.000) | 0.0274* | (0.138) | 0.0432*** | (0.004) | 0.0146 | (0.381) |
| The Army knows where narcos are | -0.0344*** | (0.026) | 0.00401 | (0.753) | 0.00791 | (0.438) | 0.0225** | (0.052) |
| I know the modus operandi of narcos | -0.0634** | (0.077) | 0.0659*** | (0.027) | 0.000112 | (0.996) | -0.00268 | (0.920) |
| Narcos' crimes can be controlled | 0.0190 | (0.232) | 0.00474 | (0.720) | -0.0504*** | (0.000) | 0.0266*** | (0.026) |
| Criminals in my region can put in danger fut. generations | -0.100*** | (0.001) | 0.00746 | (0.764) | 0.0533*** | (0.008) | 0.0397** | (0.078) |
| I'm at risk because I work in the field | -0.0485*** | (0.019) | 0.00885 | (0.606) | 0.0400*** | (0.004) | -0.000388 | (0.980) |
| I'm at risk because I transit on the roads | -0.0493*** | (0.047) | -0.0232 | (0.259) | 0.0122 | (0.457) | 0.0604*** | (0.001) |
| The presence of narcos can cause a Nat. catastrophe | 0.0297* | (0.112) | -0.0143 | (0.355) | -0.0109 | (0.377) | -0.00445 | (0.750) |
| The Army can react quickly to narcos' crimes | -0.0490*** | (0.004) | 0.0146 | (0.302) | -0.00763 | (0.501) | 0.0420*** | (0.001) |
| The risk of getting kidnap is increasing | -0.0476** | (0.095) | -0.0422** | (0.075) | 0.0520*** | (0.006) | 0.0378** | (0.078) |
| The risk of getting kidnap can be reduced | 0.0346 | (0.180) | -0.0296 | (0.167) | -0.0787*** | (0.000) | 0.0737*** | (0.000) |
| The risk of getting robbed is increasing | 0.0767*** | (0.008) | -0.104*** | (0.000) | 0.0313** | (0.100) | -0.00349 | (0.871) |
| The risk of getting robbed can be reduced | 0.0171 | (0.504) | -0.0398** | (0.062) | -0.0713*** | (0.000) | 0.0939*** | (0.000) |
| I can minimize the risk of being a crime victim | 0.0313*** | (0.014) | -0.0168* | (0.110) | 0.00685 | (0.414) | -0.0214*** | (0.025) |
| Constant | 0.934*** | (0.000) | 1.146*** | (0.000) | -0.232** | (0.094) | -0.848*** | (0.000) |
| Log Lik. | -162.8 | | -93.94 | | -10.90 | | -56.46 | |

*p*-values in parentheses. * p<0.15, ** p<0.10, *** p<0.05

The fear level clusters are distributed as follows, FearLevelG1 has 170 members, or 46% of the total; FearLevelG2 and G3 have 109 and 91 respectively, about 29 and 25%. Violence level groups have similar distribution than fear level group, ViolenceLevelG1 has 173, ViolenceLevelG2 134 and ViolenceLevelG3 61; these numbers represent 47, 36 and 16% of the total. The probability cluster however, has a very large density in the low values. ProbCrimeG1 has 215 members; ProbCrimeG2, 113, and ProbCrimeG3, 42; or 58, 30 and 11%. These numbers show that in general, farmers that overly concern about crimes in their community correspond to a small fraction. This number is even smaller when estimating probabilities of victimization.

### *Testing for Ecological Psychology System and Dual Process Theory*

Following the conditions for a system to be considered of the ecological form, we prepare the analysis in this study in a way as to comply and test those conditions. Also, following the Dual Process Theory, we examine the mechanisms in which objective assessments of risk and emotional responses to risk affect actions.

Testing the existence of an ecological system as defined by the ecological psychology theory in the context of this study require us to look at figure 1 and define under our context the mechanism to meet their conditions. We have already discussed the meaning of affordances under our context, a condition of the ecological system, and feel that the subjects of our study perceive and provide affordances; we are left to the task of meeting the condition of impredicativeness, which for our system means that each subject in the field understands that others perceive their affordances, that is, each being in the system affects and is affected by other's affordances. In our study we have two main groups of people: farmers and narcos. Testing if they both live in the same ecological system means that they are aware of each other's existence, that the actions of one group affect the other group and vice versa. In figure 6.1 this relationship is the broken arrow going from actions to stimuli (which are the actions of the narcos). That is, the actions taken by the farmers affect the actions taken by the narcos. The method to test this relationship is by means of an endogeneity test of the stimuli variable. Our results show indication of endogeneity and thus the circle of causality in the ecological system is closed.

Stimuli affect risk perceptions, but people perceive risk differently despite observing the same stimuli. How people react to stimuli is done through the classification of farmers according to their fear level using the cluster analysis previously mentioned. We believe that each group reacts different to the stimuli. This is the lower left corner of the triangle in figure 6.1. The actions taken depending on the group classification is the arrow connecting the lower left and right corners of figure 6.1. The feedback between action and risk perception, group membership, is also tested in the Hausman test for endogeneity.

A Similar approach follows for the analysis of the Dual Process System. Group membership broadly categorizes people into four groups according to their fear level and familiarity to risk. These categories represent the degree of risk perception. Using responses from the survey on probability of being victimized within the next 12 months, we created interaction terms for each group. These interaction variables measure the random effect of the probability assessment of victimization for each group. This is justified because each group has different fear measures, then each group is expected to react differently on actions taken according to their probability of victimization. For instance, we would expect that a person who believes he has a high probability of being victimized would react differently depending if he is in the fearful of confident group. This interaction term provides the deliberative effect on the Dual Process.

Similar measures of group interaction and fear level are created. In this case, these interaction terms measure the effect of emotions on actions. Again, a person who is very afraid would react differently depending on his group. Within each group there are people with different levels of fear and probability of victimization.

### *Results*

Table 6.2 shows the results of logit regression for each of the four clusters with respect to demographic, economic and psychometric variables. These clusters are defined only on the basis of the risk perception psychometric variables by Slovic. The numbers indicate the likelihood that someone belongs in any group given a value of a variable. A positive coefficient means that the effect of a variable to the likelihood of being in that group is positive. Looking at the column of Group 3, or *fearful*, we find a positive and significant coefficient for the variable sex ($b= 1.27$, $p=0.008$). The value is coded 0 for male and 1 for female. Women are more likely to be in this group than men. This is consistent to the literature on risk perception and gender. Similarly, age is negative and significant ($b= -0.035$, $p= 0.081$); the older the person, the less likely they belong in the *fearful* group. Education has a similar effect than age (b= -0.303, p= 0.049); the more educated, the less *fearful*. These results are also in accordance to previous research. However, the effect of total assets is small but positive and significant (b= $8.28*10^{-7}$, p= 0.046) for *fearful*. In the other groups this variable is not significant. Everything else equal, the more assets you have the more likely you be in the fearful group. A possible explanation is that people feel to be a target of crime if they have more wealth. Continuing on the *fearful* group, and on the questions on how they believe they are perceived by the community; being perceived as socially active has a negative and significant value (b= -1.035, p= 0.001), similarly for the *confident* group (b= -0.893, p= 0.001). The *optimistic* group has a positive value for this variable (b= 1.853, p= 0.000). Suggesting that the more socially active are less afraid. With a significance level of 12 percent, being perceived as influential also has a negative effect on the *fearful* group (b= -0.530, p= 0.121); *confident* has a positive and significant value for this variable (b= 0.693, p= 0.008). The cluster variable FearLevelG3 has a positive effect on *fearful* (b= 1.529, p= 0.045) and *optimist* (b= 1.255, p= 0.047) and a negative on *cautious* (b= -1.793, p= 0.018) and *confident* (b= -0.970, p= 0.193). The reference value for FearLevel is group 1, or the lowest level of fear. The sign of the ViolenceLevelG3 variable is negative for both *fearful* (b= -1.260, p= 0.058) and *optimist* (b= -1.392, p= 0.018) and positive for *cautious* (b= 2.163, p= 0.000). This variable is a rating people give to the violence level in their community and roads. People who rate the level of violence higher, are more likely to be *cautious* than *fearful* or *optimistic*. *Optimistic* on the other hand, is the only group that has significant positive coefficient on concern about crime on roads (b= 0.758, p= 0.006), and negative coefficient in concern about crime in their community (b= -0.697, p= 0.004).

Trust variables have significant values for *fearful* (b= -0.327, p= 0.102), *cautious* (b= -0.328, p=0.109) and *optimist* (b= 0.350, p= 0.062). This is trust in army/navy, and not trust on local police. Here the less confident you are about the army/navy, the more likely you are in the *fearful* and *cautious* groups.

Knowing a victim of crime has also a significant effect in *fearful* (b= 0.965, p= 0.009) and *cautious* (b= -1.204, p= 0.017). This variable measures the closeness to crime. People who have never experience crime, nor heard about it through a friend, are less likely to be afraid. Likewise, the closer you are to crime, the more real the violence would seem, and hence the more afraid you would be.

Religion plays a role in relieving fear. Attending religious celebrations more often has a negative effect in being *fearful* (b= -0.139, p= 0.110) and a positive effect on being *optimistic* (b= 0.113, p= 0.055). To measure religiosity we use two variables, one describes the person as being a religious person, it is self-evaluating and subjective. The other variable is more objective since it asks the number of religious celebrations attended per month on average. This is regardless of religious denomination. For denomination, we have a variable for catholic and non-catholic. In our sample, 82% of the total is catholic. This is not surprising given that it is the main religion in Mexico. The results indicate that the more religious a person is, measured in celebrations attended on average per month, the less *fearful* they are. This group also shows not to trust authorities and that risk cannot be controlled. *Optimistic* do trust authorities and have a sense of control of risk.

The variable Risk Taking Production, measures the willingness to adopt new production technologies based on three questions: Are you willing to accept greater production risks to increase the chance of higher profits?, Are you willing to take risks with new technologies before you see good results in other farms?, and Are you willing to take risks with new management practices before I see good results in other farms? *Cautious* have a significant negative coefficient on this variable (b= -2.099, p= 0.000), while *optimistic* is more willing to take risk (b= 1.864, p= 0.000).

Table 6.2.Logit regression of group clusters.

| | Group1 | p | Group2 | p | Group3 | p | Group4 | p |
|---|---|---|---|---|---|---|---|---|
| Sex | -0.618 | (0.216) | 0.0639 | (0.890) | 1.273*** | (0.008) | -0.834* | (0.135) |
| Age | 0.0273** | (0.097) | -0.00705 | (0.669) | -0.0353** | (0.081) | 0.0121 | (0.467) |
| Number of children | -0.0223 | (0.709) | -0.00816 | (0.893) | 0.0292 | (0.714) | 0.0132 | (0.822) |
| Education | 0.200* | (0.123) | -0.0317 | (0.795) | -0.303*** | (0.049) | -0.0272 | (0.828) |
| Size of group of friends | -0.0121 | (0.409) | 0.0251*** | (0.005) | -0.0122 | (0.231) | -0.0113 | (0.445) |
| Farm size | -0.00115 | (0.977) | -0.00138 | (0.972) | -0.00721 | (0.849) | -0.00643 | (0.845) |
| Revenues from farming | 1.74e-06 | (0.825) | -2.96e-06 | (0.630) | 7.77e-06 | (0.254) | -8.95e-06 | (0.321) |
| Total revenue from all sources | -4.13e-06 | (0.612) | 3.14e-06 | (0.640) | -8.35e-06 | (0.299) | 1.15e-05 | (0.190) |
| Amount of savings | -3.34e-05* | (0.125) | 2.16e-06 | (0.877) | 1.64e-05 | (0.352) | 1.85e-05 | (0.236) |
| Total asset value | -4.69e-07 | (0.421) | -3.00e-07 | (0.527) | 8.28e-07*** | (0.046) | -3.63e-07 | (0.330) |
| Risk perception of own family wrt others | 0.114 | (0.682) | 0.0362 | (0.884) | 0.227 | (0.477) | -0.183 | (0.536) |
| Believe own family is seen as asset rich | 0.152 | (0.643) | 0.127 | (0.694) | 0.429 | (0.291) | -0.241 | (0.472) |
| seen as vulnerable | 0.352 | (0.230) | -0.717*** | (0.009) | 0.0159 | (0.959) | 0.0548 | (0.854) |
| seen as socially active | 0.146 | (0.627) | -0.893*** | (0.001) | -1.035*** | (0.001) | 1.853*** | (0.000) |
| seen as cash rich | -0.113 | (0.687) | 0.499** | (0.074) | -0.0206 | (0.959) | -0.200 | (0.512) |
| seen as influential | 0.161 | (0.553) | 0.693*** | (0.008) | -0.530* | (0.121) | -0.327 | (0.230) |
| FearLevelG2 | 0.204 | (0.647) | -0.351 | (0.423) | 0.665 | (0.232) | 0.300 | (0.501) |
| FearLevelG3 | -1.793*** | (0.018) | -0.970 | (0.193) | 1.529*** | (0.045) | 1.255*** | (0.047) |
| ViolenceLevelG2 | 1.682*** | (0.000) | -0.0260 | (0.949) | -1.266*** | (0.011) | -0.680* | (0.137) |
| ViolenceLevelG3 | 2.163*** | (0.000) | -0.739 | (0.176) | -1.260** | (0.058) | -1.392*** | (0.018) |
| ProbCrimeG2 | -0.148 | (0.756) | -0.179 | (0.708) | 0.541 | (0.299) | 0.0399 | (0.927) |
| ProbCrimeG3 | -1.702 | (0.223) | 1.544* | (0.130) | 0.645 | (0.481) | -0.864 | (0.389) |
| Concerned about crime in your community | 0.167 | (0.484) | 0.185 | (0.418) | 0.0966 | (0.744) | -0.697*** | (0.004) |
| Concerned about crime on roads | -0.319 | (0.222) | -0.238 | (0.364) | -0.187 | (0.613) | 0.758*** | (0.006) |

| | Group1 | p | Group2 | p | Group3 | p | Group4 | p |
|---|---|---|---|---|---|---|---|---|
| Feel crime in your community has increased from last year | -0.0672 | (0.774) | -0.579*** | (0.010) | 0.554** | (0.061) | 0.401** | (0.076) |
| Feel road crime has increased from last year | -0.275 | (0.254) | 0.0862 | (0.690) | -0.0445 | (0.878) | 0.157 | (0.491) |
| Confidence in local police | 0.676*** | (0.002) | -0.421** | (0.063) | -0.377 | (0.159) | 0.0275 | (0.898) |
| Confidence in army/navy | -0.328* | (0.109) | 0.234 | (0.242) | -0.327* | (0.102) | 0.350** | (0.062) |
| Know victim of violent crime | -1.204*** | (0.017) | -0.509 | (0.267) | 0.965*** | (0.009) | 0.256 | (0.463) |
| Risk Taking Production | -2.099*** | (0.000) | -0.206 | (0.550) | 0.329 | (0.437) | 1.864*** | (0.000) |
| Know anybody who moved to a safer town | 0.647 | (0.167) | 0.729** | (0.082) | 0.0318 | (0.949) | -1.122*** | (0.017) |
| Considered religious person | 0.0671 | (0.637) | -0.252** | (0.056) | 0.0187 | (0.905) | 0.298*** | (0.049) |
| Religious celebrations per month | -0.0528 | (0.447) | 0.0620 | (0.301) | -0.139* | (0.110) | 0.113** | (0.055) |
| Catholic | -0.284 | (0.490) | 0.675* | (0.136) | 0.137 | (0.802) | -0.104 | (0.818) |
| Constant | -2.571 | (0.187) | 2.645 | (0.158) | 3.022 | (0.221) | -10.69*** | (0.000) |
| Log Lik. | -139.8 | | -151.2 | | -111.5 | | -138.7 | |
| Chi-squared | 162.1 | | 71.11 | | 168.4 | | 149.3 | |

*p*-values in parentheses. * p<0.15, ** p<0.10, *** p<0.05

From the results it seems that income, number of children and farm size has no effect in determining group inclusion.

Since we want to see any effect that narco violence may have on production and rural life in this geographic area, we need to proceed to evaluate different actions taken, and intentions considered by farmers due to the violence level. After generating the four distinct clusters based on some psychometric values, the effect that belonging to each cluster has on action and intentions is to be analyzed. This is akin to the relationship of the graph in figure 6.1, which comes from the ecological psychology framework. We want to analyze violence and its effects on rural life from the perspective of ecological psychology. For this we have to follow the line of thought synthesized in figure 6.1. On top of the triangle we have the stimuli, in this case are the violent actions or fear generating actions of the narcos in the community. The stimuli are observed and perceived, based on these perceptions we created the four different group categories previously described, and based on our perception of the stimuli (group membership) we act or create intentions.  These acts and intentions at the same time alter our perception. This means that after we act or create an intention, our perception can be altered directly, by not changing the stimuli; or indirectly, if our actions can alter the stimuli. In other words, our actions and intentions are endogenous to our perception

Following our analysis, we regressed actions and intentions on the dependent variables from the previous regression. Table 6.3 shows these results. The next step is to include as dependent variables three of the four clusters as dummy variables, and repeat the regression using a three-stage least square to correct for endogeneity caused by group membership, and testing using Hausman Test.

In our survey, we asked four questions that indicate actions taken and intention of actions of farmers. These questions are: Have you considered moving to another town because of the risk of being victimized?, Have you changed your production decisions because of the risk of violence?, Have you changed your daily activities because of violence?, and If the current level of violence continues, would you change your production decisions?

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Table 6.3. Regression of actions without group cluster variables.

| | Considered Moving | p | Changed Prod. Decision | p | Changed Daily Activities | p | Would Change Prod. Decision | p |
|---|---|---|---|---|---|---|---|---|
| Sex | -0.0155 | (0.888) | -0.0618* | (0.132) | 0.0185 | (0.729) | 0.00427 | (0.952) |
| Age | 0.00264 | (0.485) | 0.00362*** | (0.011) | 0.00187 | (0.310) | 0.00282 | (0.249) |
| Number of children | -0.0115 | (0.414) | -0.00621 | (0.239) | -0.0112* | (0.105) | -0.00991 | (0.278) |
| Education | 0.0277 | (0.335) | 0.0111 | (0.301) | -0.00258 | (0.854) | 0.0373*** | (0.046) |
| Size of group of friends | 0.00513*** | (0.034) | 0.00389*** | (0.000) | 0.00131 | (0.268) | 0.000198 | (0.900) |
| Farm size | 0.0181*** | (0.023) | 0.00533** | (0.073) | 0.00629* | (0.105) | 0.00267 | (0.603) |
| Revenues from farming | 4.60e-08 | (0.976) | 5.50e-07 | (0.343) | 8.68e-07 | (0.252) | 1.05e-06 | (0.297) |
| Total revenue from all sources | -4.12e-07 | (0.809) | -2.07e-07 | (0.745) | -1.14e-07 | (0.891) | -1.33e-06 | (0.230) |
| Amount of savings | -3.87e-06 | (0.303) | -1.82e-06 | (0.196) | -4.16e-06*** | (0.024) | -2.90e-07 | (0.905) |
| Total asset value | 8.35e-09 | (0.930) | 1.70e-09 | (0.962) | -5.61e-08 | (0.225) | -1.08e-08 | (0.859) |
| Risk perception of own family wrt others | 0.230*** | (0.000) | 0.0313 | (0.174) | -0.0260 | (0.386) | 0.00494 | (0.901) |
| Believe own family is seen as asset rich | -0.118* | (0.115) | 0.0295 | (0.290) | 0.0284 | (0.434) | 0.0253 | (0.599) |
| seen as vulnerable | -0.108** | (0.072) | -0.0431** | (0.055) | -0.0189 | (0.517) | -0.0622* | (0.110) |
| seen as socially active | 0.157*** | (0.008) | 0.0563*** | (0.011) | 0.0325 | (0.258) | 0.164*** | (0.000) |
| seen as cash rich | 0.0387 | (0.578) | 0.0100 | (0.700) | -0.00558 | (0.869) | 0.0700* | (0.120) |
| seen as influential | 0.0303 | (0.634) | -0.00420 | (0.860) | 0.0525** | (0.092) | 0.0112 | (0.787) |
| FearLevelG2 | -0.0285 | (0.792) | 0.00122 | (0.976) | 0.0847* | (0.110) | 0.237*** | (0.001) |
| FearLevelG3 | 0.184 | (0.232) | 0.151*** | (0.009) | 0.112* | (0.137) | 0.342*** | (0.001) |
| ViolenceLevelG2 | 0.0353 | (0.740) | 0.0205 | (0.607) | 0.0164 | (0.753) | -0.0398 | (0.564) |
| ViolenceLevelG3 | 0.0801 | (0.543) | -0.00498 | (0.920) | -0.0540 | (0.401) | -0.142** | (0.096) |
| ProbCrimeG2 | 0.0830 | (0.453) | 0.0340 | (0.411) | 0.106*** | (0.050) | -0.158*** | (0.028) |
| ProbCrimeG3 | -0.0252 | (0.905) | 0.0291 | (0.713) | 0.117 | (0.258) | -0.0525 | (0.702) |
| Concerned about crime in your community | -0.0298 | (0.590) | -0.0125 | (0.547) | 0.00247 | (0.927) | -0.000118 | (0.997) |
| Concerned about crime on roads | 0.0699 | (0.283) | -0.00842 | (0.729) | 0.00241 | (0.940) | 0.0535 | (0.205) |

| | Considered Moving | p | Changed Prod. Decision | p | Changed Daily Activities | p | Would Change Prod. Decision | p |
|---|---|---|---|---|---|---|---|---|
| Feel crime in your community has increased from last year | -0.00610 | (0.910) | -0.000561 | (0.978) | 0.0134 | (0.612) | 0.0157 | (0.654) |
| Feel road crime has incr. from last year | -0.00876 | (0.873) | 0.00308 | (0.881) | -0.00631 | (0.814) | -0.00704 | (0.843) |
| Confidence in local police | 0.0289 | (0.560) | -0.0326** | (0.079) | 0.0125 | (0.605) | -0.0434 | (0.176) |
| Confidence in army/navy | 0.0397 | (0.351) | 0.00208 | (0.896) | -0.00160 | (0.939) | 0.0404* | (0.144) |
| Know victim of violent crime | -0.0710 | (0.414) | 0.0548** | (0.092) | 0.0886*** | (0.037) | 0.00636 | (0.910) |
| Risk Taking Production | -0.160** | (0.056) | -0.0164 | (0.599) | -0.0451 | (0.269) | 0.0671 | (0.216) |
| Know anybody who moved to a safer town | 0.267*** | (0.009) | 0.0835*** | (0.030) | 0.162*** | (0.001) | 0.0559 | (0.399) |
| Considered religious person | 0.0189 | (0.545) | 0.0109 | (0.351) | -0.00120 | (0.937) | -0.0258 | (0.202) |
| Religious celebrations per month | 0.00125 | (0.932) | -0.00121 | (0.824) | 0.00249 | (0.726) | -0.00150 | (0.873) |
| Catholic | -0.0625 | (0.537) | -0.0507 | (0.181) | 0.0151 | (0.759) | 0.0340 | (0.604) |
| Constant | -0.130 | (0.771) | -0.351*** | (0.036) | -0.285 | (0.192) | -0.709*** | (0.015) |
| Log Lik. | -350.3 | | 8.683 | | -88.52 | | -191.8 | |

*p*-values in parentheses. * p<0.15, ** p<0.10, *** p<0.05

Looking at table 6.3, men are more likely to have changed production decisions than women (b= -0.0618, p= 0.132). Perhaps this reflects the roles of genders in the family. Older people are more likely to have changed production due to the risk of violence (b= 0.0036, p= 0.011). Education plays a role when considering changing production practices in the future if violence continues to the current level (b= 0.0373, p=0.046). More educated people would consider changing production practices. The size of group of friends has a positive effect in having considered moving (b= 0.0051, p= 0.034), and in people who changed production practices (b= 0.0038, p= 0.000). Changes in our lives apparently are easier the more friends we have. Unlike the previous regression, here farm size has a positive and significant effect in having changed production decisions (b= 0.0053, p= 0.073), in having considered moving (b= 0.0181, p= 0.023), and in having changed daily activities (b= 0.0062, p= 0.105). Income and asset value has no impact on actions and intentions. Social life also plays an important part in taking actions. It is significant for all actions except for having changed daily activity: considered moving (b= 0.157, p= 0.008), changed production decisions (b= 0.0563, p= 0.011), would change production decision if violence continues (b= 0.164, p=0.000). This may be related to the amount of support that we get through friends, like the size of group of friends, makes difficult decision-taking easier. Fear level is an important drive for changes in activities and intentions. Knowing someone who has moved out of town because of violence is a strong factor to take actions. It is significant for three actions at very low p-values: considered moving (b= 0.267, p= 0.009), changed production decisions (b= 0.0835, p= 0.030), changed daily activities (b= 0.162, p=0.001). Like knowing a victim of crime, these variables tell us that the risk is real and next to us.

Three-stage least squares is used because it is a method to solve a system of equations simultaneously in which some variables are endogenously determined and the error terms among equations are correlated. In the presence of correlation across the error terms, OLS estimates are inconsistent. Unlike two-stage least squares, which solve the system one equation at a time without considering the covariance structure across equations, 3SLS is more efficient when there is correlation among equations' disturbances (P. Kennedy, 2003). After inspecting the covariance matrix of the set of equations, we found evidence of cross correlation among equations. For this, it is reasonable to use the 3SLS to account for non-diagonal covariance matrix

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***Hausman Test for Endogeneity in the Ecological Psychology System***

To justify the use of a 2SLS or 3SLS model, we need to show that endogeneity exists in our set of equations. This can occur is there is simultaneity in our model, for instance, if in a system of equations two regressands affect each other. Endogeneity can be tested using a Hausman test. In this test, if we have a set of equations with the regressands being endogenous to the system, first we need to regress a variable that is believed to be endogenous with respect to all exogenous variables. Then using the estimated value of that endogenous variable, perform the original regression with both the empirical and the estimated value of the endogenous variable as regressors including all exogenous variables. If the coefficient of the estimated variable is not statistically different from zero, we can say that there is evidence of endogeneity and the use of 2 or 3SLS is justified.

In our model, the original equations are actions dependent on group membership and stimuli.

$$A_1 = \alpha_{0,1} + \boldsymbol{X}_a \boldsymbol{\alpha}'_{a,1} + \alpha_{2,1} G_1 + \alpha_{3,1} G_3 + \alpha_{4,1} G_4 + \alpha_{5,1} S_1 + \alpha_{6,1} S_2 + \nu_1$$

$$A_2 = \alpha_{0,2} + \boldsymbol{X}_a \boldsymbol{\alpha}'_{a,2} + \alpha_{2,2} G_1 + \alpha_{3,2} G_3 + \alpha_{4,2} G_4 + \alpha_{5,2} S_1 + \alpha_{6,2} S_2 + \nu_2$$

$$A_3 = \alpha_{0,1} + \boldsymbol{X}_a \boldsymbol{\alpha}'_{a,3} + \alpha_{2,3} G_1 + \alpha_{3,3} G_3 + \alpha_{4,3} G_4 + \alpha_{5,3} S_1 + \alpha_{6,3} S_2 + \nu_3$$

$$A_4 = \alpha_{0,1} + \boldsymbol{X}_a \boldsymbol{\alpha}'_{a,4} + \alpha_{2,4} G_1 + \alpha_{3,4} G_3 + \alpha_{4,4} G_4 + \alpha_{5,4} S_1 + \alpha_{6,4} S_2 + \nu_4$$

To test for endogeneity of $S$ and $G$ we need to regress each endogenous variable with respect to the exogenous variables.

$$S_1 = \beta_{0,1} + \boldsymbol{X}_a\boldsymbol{\gamma}'_{a,1} + \sum_{n=1}^{4} \beta_{n,1}A_n + \varepsilon_1$$

$$S_2 = \beta_{0,2} + \boldsymbol{X}_a\boldsymbol{\gamma}'_{a,2} + \sum_{n=1}^{4} \beta_{n,2}A_n + \varepsilon_2$$

$$G_1 = \beta_{0,3} + \boldsymbol{X}_a\boldsymbol{\gamma}'_{a,3} + \boldsymbol{X}_g\boldsymbol{\gamma}'_{b,3} + \varepsilon_3$$

$$G_3 = \beta_{0,4} + \boldsymbol{X}_a\boldsymbol{\gamma}'_{a,4} + \boldsymbol{X}_g\boldsymbol{\gamma}'_{b,4} + \varepsilon_4$$

$$G_4 = \beta_{0,5} + \boldsymbol{X}_a\boldsymbol{\gamma}'_{a,5} + \boldsymbol{X}_g\boldsymbol{\gamma}'_{b,5} + \varepsilon_5$$

$S_1$ and $S_2$ are the stimuli that farmers perceive in regarding to the violence in their community. Specifically, they are the answers to the questions: Do you know somebody who has been a victim of violent crime?, and Do you know somebody who has moved to another town for fear of being victim of crime? From the impredicativeness condition of the ecological system, we test a feedback effect between the beings in the environment, farmers and narcos. We need to test if actions affect the stimuli which in turn affect risk perception as well. This feedback effect is crucial in determining if a given social system comprises an ecological psychology system. The vector of independent variables $\boldsymbol{X}_a$ includes all control and independent variables that determine actions taken. This vector should be included in the regression of each endogenous variable.

$G_1$ to $G_4$are dummy variables indicating each individual's group. $G_2$is used as a baseline for comparison, thus it is not included in the equations. These regressions also include the vector of independent variables $\boldsymbol{X}_a$, and another vector $\boldsymbol{X}_g$ of instruments. These instruments are the variables used in determining each cluster (group) of farmers. They are the Slovic variables to measure degree of fear and understanding of risks.

From the previous regressions, we obtain the estimated value of each outcome variable $S$ and $G$, and use those estimated variables as regressors as part of the original equations. The estimated values $\hat{S}$ and $\hat{G}$ become instruments in the original structural equation. We use their estimates as well as their original values to run an OLS regression.

$$A_1 = \alpha_{0,1} + X_a \alpha'_{a,1} + \sum_{i=1,3,4} \alpha_{i,1} G_i + \delta_{1,1} \hat{G}_1 + \delta_{2,1} \hat{G}_3 + \delta_{3,1} \hat{G}_4 + \alpha_{5,1} S_1 + \delta_{4,1} \hat{S}_1 + \alpha_{6,1} S_2 + \delta_{5,1} \hat{S}_2 + v_1^*$$

$$A_2 = \alpha_{0,2} + X_a \alpha'_{a,2} + \sum_{i=1,3,4} \alpha_{i,2} G_i + \delta_{1,2} \hat{G}_1 + \delta_{2,2} \hat{G}_3 + \delta_{3,2} \hat{G}_4 + \alpha_{5,2} S_1 + \delta_{4,2} \hat{S}_1 + \alpha_{6,2} S_2 + \delta_{5,2} \hat{S}_2 + v_2^*$$

$$A_3 = \alpha_{0,3} + X_a \alpha'_{a,3} + \sum_{i=1,3,4} \alpha_{i,3} G_i + \delta_{1,3} \hat{G}_1 + \delta_{2,3} \hat{G}_3 + \delta_{3,3} \hat{G}_4 + \alpha_{5,3} S_1 + \delta_{4,3} \hat{S}_1 + \alpha_{6,3} S_2 + \delta_{5,3} \hat{S}_2 + v_3^*$$

$$A_4 = \alpha_{0,4} + X_a \alpha'_{a,4} + \sum_{i=1,3,4} \alpha_{i,4} G_i + \delta_{1,4} \hat{G}_1 + \delta_{2,4} \hat{G}_3 + \delta_{3,4} \hat{G}_4 + \alpha_{5,4} S_1 + \delta_{4,4} \hat{S}_1 + \alpha_{6,4} S_2 + \delta_{5,4} \hat{S}_2 + v_4^*$$

Once we have estimates of the coefficients for each regressor, we can perform a F-test for $\delta_{1,n} = \delta_{2,n} = \delta_{3,n} = \delta_{4,n} = \delta_{5,n} = 0$. If this hypothesis is rejected, we can say that the variables are endogenous; otherwise it is evidence that they are exogenous. The resulting p-value of our F-test performed is 0.00 indicating that we can treat those variables as endogenous. Rejecting the test provides evidence of endogeneity in the system (Gujarati, 2003; Kennedy, 2003). In this case, it means that perception in the form of group membership is endogenously determined in the system. Rejecting the test complies with the condition of impredicativeness in the ecological psychology framework. It provides support of a feedback between action and stimuli also.

### ***Intentions and Actions in the Dual Process Theory***

The results of the three-stage least squares (3SLS) are presented in tables 6.4 and 6.5. Table 6.4 shows the result of the regression of actions and intentions with respect to group membership and other risk and control variables. Table 6.5 shows the results of regressing demographic variables on group membership. The results are consistent to the results from table 6.2, using a Logit regression. Since it is not included in the 3SLS regression, results for group 2 were estimated separately using OLS regression. These results were already commented in table 6.2 and are shown here for illustration of the different regressions.

Results from table 6.4 are used to measure the effect of emotions and rational assessment of an event on people's actions. Using each group as a category to individual risk perception, and interaction terms that denote group effects on probability assessment of risk, and on emotional reaction to risks, we are able to determine the effect for each group of these two mechanisms.

Other variables used as regressors in table 6.4 are mostly about perception of current violence conditions, likelihood of victimization, fear of victimization, trust in authorities, how own family is perceived with respect to others in the community, knowledge of anybody who has been victimized and on risk taking attitudes toward production. Group membership on its own shows significance for some actions and intentions in relation to Group 2 (confident). For instance, *fearful* (Group 3) are more likely to have changed production due to crime (b= 0.765, p=0.112) compared to *confident*. Similarly, c*autious* (b=0.643, p=0.184) and *optimistic* (b=0.486, p=0.166) also have positive coefficients but marginally significant. for change production if crime continues (b= -0.751, p= 0.116). We exclude Group 2 from the analysis to avoid dummy trap, thus the results are in relation to this group. Group 2 was selected since it doesn't show extreme values of fear that the other groups have, results are easier to compare when the benchmark is low fear level.

None of the groups show significance from the first action: have considered moving out of town. This means that all of the groups are equally likely to take this action. In the second action however, being *fearful* is negatively significant (b = -0.691; p=0.004), and in the fourth action/intention being *optimistic* is also negatively significant (b= -0.751; p=0.116). This means that compared to *confident*, a *fearful* is less likely to have changed production due to crime; and an *optimist* is also less likely to change his production if crime continues.

Fear level, independent of group membership, plays an important role in deciding actions and intentions. Having a high level of fear of becoming a crime victim has a positive effect in the likelihood of taking an action/intention to prevent it, from changing production practices, to changes in daily life and considering moving to another town. By the same token, if you perceive your family to be more at risk with respect to other families in the community, you are more likely to have considered moving (b= 0.252, p= 0.00), and to have changed production decisions (b= 0.047, p= 0.06).

The variables used to determine the effects of the two systems in the dual process are explained next. Under the Dual Process theory the emotional effect (system 1) on actions are given by the variables FearLevel Low and FearLevel High, and their interaction for each group. For instance, for group 1 they are G1LowFear, G1HighFear, and similarly for the other groups. The deliberative effect (system 2), or rational, are given by the variables PLI and PHL which stands for probability of low impact crime, and high impact crime, and their corresponding interaction for each group. Low impact crimes are theft and physical aggression; high impact crimes are kidnapping, extortion and homicide. The marginal effect of the emotional or deliberative response on each group is the sum of that variable and their interaction term. The effect of each decision process (emotional and deliberative) on action is measured by the size of their marginal effect. From these values we can determine which decision component dominates each group. The marginal effects are given in table 6.6. For clarity, only the marginal effects of high level of fear (system 1) and probability of being a victim of a high impact crime in the next 12 months (system 2) are presented. For groups 1, 3 and 4, only the p-values of the interaction term are reported.

Table 6.4.Three-stage least squares regression of actions on groups membership and farmer characteristics. Results are in relation to group 2.

| | Have Considered Moving Out of Town | | Changed Production due to Crime | | Change Lifestyle due to Crime | | Change Production If Crime Continues | |
|---|---|---|---|---|---|---|---|---|
| | **Coefficient** | **p** | **Coefficient** | **p** | **Coefficient** | **p** | **Coefficient** | **p** |
| Female | -0.000570 | (0.996) | -0.0446 | (0.317) | 0.000994 | (0.986) | -0.0310 | (0.651) |
| Age | 0.00511 | (0.195) | 0.00280** | (0.082) | 0.00116 | (0.565) | 0.00354 | (0.152) |
| Number of children | -0.0145 | (0.300) | -0.00693 | (0.226) | -0.0138** | (0.054) | -0.00927 | (0.292) |
| Education | 0.0511* | (0.111) | -0.00193 | (0.883) | -0.0127 | (0.439) | 0.0405*** | (0.044) |
| Size of group of friends | 0.00385 | (0.172) | 0.00259*** | (0.025) | 0.000924 | (0.523) | -0.00123 | (0.486) |
| Farm Size | 0.0218*** | (0.007) | 0.00771*** | (0.020) | 0.00496 | (0.232) | 0.00524 | (0.302) |
| Farm Revenue | 0.00000138 | (0.380) | 0.000000480 | (0.456) | 0.00000066 | (0.413) | 0.00000105 | (0.288) |
| Total Revenue | -0.00000193 | (0.277) | -0.000000743 | (0.305) | 0.00000014 | (0.875) | -0.0000019** | (0.091) |
| Total Savings | -0.00000310 | (0.431) | -0.00000202 | (0.209) | -0.0000039** | (0.054) | -0.0000004 | (0.858) |
| Asset Value | 3.44e-08 | (0.721) | -3.58e-09 | (0.927) | -6.04e-08 | (0.221) | -3.45e-08 | (0.568) |
| Group 1 | -2.393*** | (0.043) | 0.643 | (0.184) | 0.822 | (0.175) | -0.102 | (0.891) |
| Group 3 | -0.991 | (0.401) | 0.765* | (0.112) | 0.486 | (0.421) | 0.281 | (0.702) |
| Group 4 | -1.180 | (0.172) | 0.489 | (0.166) | 0.197 | (0.657) | 0.0155 | (0.977) |
| Pr. Low Impact Crime (PLI) | -0.613 | (0.181) | 0.340** | (0.069) | 0.199 | (0.396) | 0.255 | (0.373) |
| Pr. High Impact Crime (PHI) | -0.0599 | (0.783) | -0.116 | (0.191) | 0.0485 | (0.662) | -0.240** | (0.077) |
| G1 PLI | 1.101** | (0.085) | -0.397* | (0.128) | -0.359 | (0.272) | -0.280 | (0.483) |
| G1 PHI | 0.137 | (0.609) | 0.0997 | (0.361) | -0.0484 | (0.724) | 0.264* | (0.114) |
| G3 PLI | 0.581 | (0.303) | -0.467*** | (0.042) | -0.257 | (0.371) | -0.409 | (0.244) |
| G3 PHI | -0.0893 | (0.707) | 0.133 | (0.171) | -0.00963 | (0.937) | 0.297*** | (0.046) |
| G4 PLI | 0.538 | (0.276) | -0.353** | (0.080) | -0.0752 | (0.766) | -0.418 | (0.175) |
| G4 PHI | 0.280 | (0.250) | 0.132 | (0.184) | -0.0225 | (0.856) | 0.333*** | (0.029) |
| FearLevel Low | 0.358 | (0.253) | -0.173 | (0.178) | 0.0374 | (0.816) | 0.0331 | (0.866) |
| FearLevel High | 1.599*** | (0.034) | -0.0927 | (0.763) | -0.181 | (0.639) | 0.461 | (0.327) |
| G1Low Fear | -0.589* | (0.138) | 0.345*** | (0.034) | 0.0858 | (0.673) | 0.0585 | (0.814) |
| G1High Fear | -2.283*** | (0.022) | 0.0801 | (0.844) | 0.473 | (0.356) | -0.137 | (0.826) |
| G3Low Fear | -0.171 | (0.646) | 0.0814 | (0.593) | 0.290* | (0.129) | 0.0213 | (0.927) |
| G3High Fear | -0.902 | (0.260) | 0.276 | (0.400) | 0.407 | (0.322) | -0.260 | (0.604) |
| G4Low Fear | -0.262 | (0.479) | 0.124 | (0.410) | -0.0949 | (0.616) | 0.357* | (0.123) |
| G4High Fear | -1.689*** | (0.033) | 0.291 | (0.367) | 0.201 | (0.618) | -0.122 | (0.805) |

| | Have Considered Moving Out of Town | | Changed Production due to Crime | | Change Lifestyle due to Crime | | Change Production If Crime Continues | |
|---|---|---|---|---|---|---|---|---|
| | **Coefficient** | **p** | **Coefficient** | **p** | **Coefficient** | **p** | **Coefficient** | **p** |
| Risk perception wrt others | 0.191*** | (0.006) | 0.0343 | (0.223) | -0.0350 | (0.322) | -0.00309 | (0.943) |
| Perc. Family as Asset Rich | -0.146** | (0.054) | 0.0349 | (0.259) | 0.0383 | (0.325) | 0.0187 | (0.694) |
| Perc. Family as Vulnerable | -0.0866* | (0.148) | -0.0372* | (0.127) | -0.00951 | (0.756) | -0.0268 | (0.474) |
| Perc. Family as Influential | 0.0266 | (0.686) | -0.000581 | (0.983) | 0.0424 | (0.207) | 0.0157 | (0.702) |
| ViolenceLevel Low | 0.133 | (0.273) | 0.0493 | (0.320) | 0.0106 | (0.864) | 0.00460 | (0.952) |
| ViolenceLevel High | 0.151 | (0.343) | 0.0773 | (0.235) | -0.0648 | (0.427) | -0.0772 | (0.439) |
| Concerned Crime in Town | -0.0216 | (0.715) | -0.0169 | (0.484) | 0.00849 | (0.779) | -0.00866 | (0.815) |
| Concerned Crime on Roads | -0.0193 | (0.780) | -0.0270 | (0.338) | -0.00567 | (0.873) | 0.0570 | (0.188) |
| Feel Crime in Town has Increased from Last Year | -0.00166 | (0.980) | -0.0388 | (0.159) | 0.00448 | (0.897) | 0.00431 | (0.919) |
| Feel Road Crime has Increased from Last Year | -0.0278 | (0.618) | -0.00861 | (0.705) | -0.00701 | (0.806) | -0.0156 | (0.656) |
| Confidence in Police | 0.0355 | (0.500) | -0.0177 | (0.410) | 0.0198 | (0.463) | -0.0331 | (0.316) |
| Confidence in Army/Navy | 0.0257 | (0.596) | 0.0229 | (0.248) | -0.00253 | (0.919) | 0.0532** | (0.080) |
| Know Victim of Crime | -0.354 | (0.249) | 0.463*** | (0.000) | 0.302** | (0.055) | 0.414*** | (0.031) |
| Know Anybody who moved to a Safer Town | 0.603** | (0.094) | 0.532*** | (0.000) | -0.0297 | (0.872) | 0.0754 | (0.737) |
| Constant | 1.350** | (0.078) | -0.554** | (0.076) | -0.628* | (0.109) | -0.782* | (0.101) |
| Chi Squared | 128.49 | | 208.80 | | 93.60 | | 182.15 | |

*p*-values in parentheses. * p < 0.15, ** p < 0.10, *** p < 0.05

Table 6.5.Three-stage least squares regression of demographic characteristics on group membership.

| | Group 1 (Cautious) | | Group 2[a] (Confident) | | Group 3 (Fearful) | | Group 4 (Optimistic) | |
|---|---|---|---|---|---|---|---|---|
| | **Coefficient** | **P-value** | **Coefficient** | **P-value** | **Coefficient** | **P-value** | **Coefficient** | **P-value** |
| Sex | -0.0639 | (0.333) | -0.0194 | (0.761) | 0.190*** | (0.002) | -0.123** | (0.055) |
| Age | 0.00301 | (0.179) | -0.000727 | (0.743) | 0.00436*** | (0.041) | 0.000806 | (0.710) |
| Number of children | -0.0189*** | (0.019) | -0.00415 | (0.611) | 0.0139** | (0.071) | 0.0103 | (0.185) |
| Education | 0.0214 | (0.216) | -0.0106 | (0.541) | -0.0194 | (0.240) | 0.00525 | (0.755) |
| Size of group of friends | -0.00189 | (0.190) | 0.00224* | (0.105) | -0.000985 | (0.468) | -0.000529 | (0.707) |
| Farm size | 0.000866 | (0.849) | -0.00201 | (0.666) | 0.00215 | (0.622) | -0.00257 | (0.558) |
| Revenue from farming | 0.00000015 | (0.863) | 9.33e-08 | (0.919) | 0.00000084 | (0.325) | 0.0000014** | (0.100) |
| Total revenue from all sources | 0.00000043 | (0.658) | 0.000000123 | (0.901) | 0.00000099 | (0.285) | 0.0000016** | (0.083) |
| Savings | 0.0000036* | (0.105) | 0.000000924 | (0.681) | 0.00000161 | (0.450) | 0.00000118 | (0.589) |
| Total asset value | -6.58e-08 | (0.239) | -4.15e-08 | (0.458) | 4.87e-08 | (0.359) | 3.40e-08 | (0.529) |
| Considered religious | 0.0126 | (0.500) | -0.0219 | (0.234) | -0.0245 | (0.167) | 0.0290* | (0.112) |
| Religious celebrations | -0.00432 | (0.609) | -0.0000977 | (0.991) | -0.00128 | (0.873) | 0.00833 | (0.310) |
| Catholic | -0.105** | (0.068) | 0.0442 | (0.448) | 0.0957** | (0.082) | -0.0206 | (0.711) |
| Constant | 0.300** | (0.075) | 0.356*** | (0.034) | 0.408*** | (0.011) | 0.0333 | (0.839) |
| Chi Squared | 21.55 | | | | 23.88 | | 16.18 | |

*p*-values in parentheses. * $p<0.15$, ** $p<0.10$,*** $p<0.05$

a. Group 2 was the reference in the three-stage least squared regression, thus, it was not included in the model. The results shown here are from an ols regression and no Chi Squared value is provided.

The type of action taken also determines what decision processes are more important for each group. We focus, for the rest of the dual process analysis, on the variable FearLevel High as indicator of the magnitude of emotional response, and PHI (Probability of High Impact Crime) as indicator of the magnitude of the deliberative process.

Consider the action "Changed Production due to Crime"; by looking at the significance level of the coefficients we see that all groups are more dependent on the emotional decision mechanism than on the rational. From the coefficient of group 1 (cautious), it is shown that it changed its production due to crime, albeit with a marginal significance. However, looking at its components of the dual process, the rational process of this group has more weight than the emotional process in this decision, again, marginally. This is estimated by the marginal effect of rational process (-0.016) and that of the emotional process (-0.012). Group 3, or *fearful*, responded more to the emotional process (0.183) than the rational process (0.017) in changing production due to crime. Group 4, *optimistic*, like group 3 responded more to emotions than to rational assessments of risks; the marginal effects of the two systems are 0.198 and 0.016 respectively.

The response to "Have Considered Moving out of Town", however, resulted in the system 1 dominating the decision making process. All groups, except group 3, show significant coefficients for system 1.For instance, the marginal effects of the rational and emotional systems for group 1 are 0.077 (p= 0.609) and -0.684 (p= 0.022) respectively. The negative sign in the emotional response indicates that high fear level decreased the chance of having considered moving out of town, acting in opposite direction as the rational system, which has a positive effect on the decision (0.077). However, only the coefficient in the emotional system is significant. Group 4, *optimistic*, behaves in a similar way. Its coefficient for the emotional component is negative and significant (b= -0.090, p= 0.033); its rational component is positive but not significant (b= 0.220, p= 0.250). Just like group 1, group 4 reacted to a high level of fear by not considered moving out of town. Only group 2, *confident*, reacted to a high level of fear by considering moving out of town. Group 3, albeit statistically insignificant, also have large and positive coefficient for the emotional component (b= 0.697) while the rational process is negative and smaller in magnitude (-0.149). That is, *fearful* group would act positively to moving out of town because of emotions, but their rational system would act in opposite direction (by not moving out of town) but at a much smaller magnitude.

The action "Changed Production due to Crime", similar to "Change Production if Crime Continues", has the system 2 dominating the decision making process, although the statistical significance is lower. The sign of the coefficients for groups 2, 3 and 4 for system 2 remains the same as in the fourth action. Group 1 has a negative sign for system 2; however the p-value is 0.36. The coefficients and p-values, in parenthesis, for groups 2, 3 and 4 in system 2 are the following: -0.116 (0.191); 0.017 (0.171) and 0.016 (0.184). The coefficients for the system 1 have p-values larger than 0.367. This is evidence that for this particular action, system 2 dominates system 1 in the decision process.

The third action, "Changed Lifestyle due to Crime", does not have a system dominating the other in the decision making process. This does not indicate that either system is not present in the decision process but rather that the weights of each system in the decision may be the same.

Table 6.6. Marginal effect of each system on actions. P-values in parenthesis.

| | **Have Considered Moving out of Town** | **Changed Production due to Crime** | **Changed Lifestyle due to Crime** | **Change Production if Crime Continues** |
|---|---|---|---|---|
| **System 1** High Fear Level | | | | |
| Group 1 | -0.684 | -0.0126 | 0.292 | 0.324 |
| | (0.022) | (0.844) | (0.356) | (0.826) |
| Group 2 | 1.599 | -0.0927 | -0.181 | 0.461 |
| | (0.034) | (0.763) | (0.639) | (0.327) |
| Group 3 | 0.697 | 0.1833 | 0.226 | 0.201 |
| | (0.260) | (0.400) | (0.322) | (0.604) |
| Group 4 | -0.090 | 0.1983 | 0.020 | 0.339 |
| | (0.033) | (0.367) | (0.618) | (0.805) |
| **System 2** Prob. High Impact Crime | | | | |
| Group 1 | 0.0771 | -0.0163 | 0.0001 | 0.024 |
| | (0.609) | (0.361) | (0.724) | (0.114) |
| Group 2 | -0.0599 | -0.116 | 0.0485 | -0.240 |
| | (0.783) | (0.191) | (0.662) | (0.077) |
| Group 3 | -0.1492 | 0.017 | 0.0388 | 0.057 |
| | (0.707) | (0.171) | (0.937) | (0.046) |
| Group 4 | 0.2201 | 0.016 | 0.026 | 0.093 |
| | (0.250) | (0.184) | (0.856) | (0.029) |

An important observation is that for almost every group and action, the emotional system has a much larger magnitude than the rational system. A caveat in this statement is that we look at magnitudes of the coefficients without considering statistical significance. One possible reason for this is that all subjects, by being exposed to violence, have their emotional part of the decision making process more active than their rational part. Their emotional component of the decision making process might be overwhelmed by the exposure to negative stimuli (narco violence).

This finding is similar to the findings in Schulze and Wansink (2012), where by lowering individual's cognitive load, their deliberative system has more effect in their decisions. In our study, farmers are overwhelmed by the amount of negative stimuli. In their example, participants who were given less tasks, and thus using their deliberative system less, has less reaction to stigma.

The influence of positive emotions on stigma is also observed by our results. In an experimental work on stigma and the offsetting influence of positive emotions, Messer et al. (2010), find that the stigma of mad cow disease (BSE) on willingness to pay for a hamburger can be offset by positive advertising on beef. In their study, participants were shown various advertisements to after watching a news clip on BSE. The positive emotional treatment was a generic advertisement for beef. We found similarities in our study to that experiment. In our individual categorizations, each group member shares certain characteristics about their attitudes towards risk (cautious, confident, fearful and optimistic) which also represents their optimism and pessimism about their current situation. This is related to the offsetting of stigma by positive emotions; however, in the group case these positive emotions are endogenous within each group. Following the results of Messer et al., offsetting the negative stigma created by the presence of narcos by means of positive emotions might be a way to reduce anxiety in the community. How these positive emotions are to be conveyed to the farmers is a matter of further discussion.

Control variables that also play a role in decision making but not included in the Dual Process model are given next. Age, for instance, has a positive effect on all actions, and statistically significant, or marginally significant at $p < 0.195$, for three of the four actions. The older a person is, the more likely he is taking an action. Number of children has a negative value for all actions, but significant for changing lifestyle with $p = 0.54$. Education is positive and significant for considering moving out of town ($p = 0.11$), and for changing production if violence continues ($p = 0.04$). More educated people can adopt different production technologies more easily than less educated people. Having a large group of friends has a positive effect on considering moving out of town and on having changed production. This may be the case if by having more friends the opportunity to know somebody in another town who can help them move increases. The effect on having changed production can be explained by group support in adopting new technology. It is easier to change production if somebody in your group of friends already has or has access to the required technology. Having a large farm increases the chance of moving out of town and on changing production as well. Knowing a victim of a crime or knowing someone who has moved out of town because of violence is a significant indicator of actions/intentions. People who know somebody who has been victimized, under the context of this research, is more likely to change production decisions if crime continues ($b= 0.414$, $p=0.031$), more likely to have changed daily activities ($b= 0.302$, $p=0.055$), and to have changed production ($b = 0.463$, $p = 0.00$). Knowing somebody who has moved out of town because of fear of crime have an effect in considering moving out of town too ($b= 0.603$, $p=0.094$), and in having changed production practices ($b= 0.532$, $p=0.00$).

### *Conclusion and Further Discussion*

This chapter analyses the effect of drug violence in a rural area in Mexico where this type of violence is relatively new, using the framework of the ecological psychology and dual theory process. We found various significant factors that explain fear among farmers, and how that fear is affecting rural life and production decisions.

In this analysis, using a variety of established psychometric models to determine degree of fear developed by Slovic, I was able to create through cluster analysis four groups that classify people according to their fear perception and feeling of control. These groups are labeled Optimistic, Fearful, Pessimistic and Confident. We analyze the effect of demographic and economic variables in determining group membership, and on actions/intentions in response to fear. Using a Hausman Test, we found evidence that stimuli are endogenously determined by actions.

Another interesting finding of this study is that decisions of the subject can be explained under the Dual Process approach. This theory, although does not substitute the ecological psychology approach, is contained in the ecological framework. Dual process explains behavior under risk as the result of two decision making mechanisms: an emotional, irrational, reaction based mechanism; and a deliberated, rational, non-emotional mechanism. I was able to measure the degree of emotional response and deliberative response to risk according for each action. The emotional response to risk is determined by group membership. Group membership categorizes people according to their degree of fear and control of risky events. That is, it measures the fear level, of farmers. The measure of deliberate response to risk is related to their probability assessments of risky events. Farmers responded to the degree of likelihood that they, or their family members, would become a victim of narco related crimes within the next 12 months. The coefficient of the probabilistic estimations of adverse events on actions provides a measure of the effect of the rational mechanism in decision making. The combination of these coefficients (group membership and probability of victimization) gives the elements for decision making under the dual process model.

This chapter also contributes to the application of the ecological psychology paradigm. To our knowledge this is the first study that supports the existence of an ecological environment in a social study. How we respond to the environment is determined by our perception of them. Our actions resulting from our perception of those forces alters our perception in a circular way. Our results are in accordance to the conditions under the ecological psychology framework. Our system is in the scale of perception-action, farmers respond to drug violence; they connect to the formalism of affordances, they refer to the exogenous variables in our model; they are more general than the laws of inanimate systems; and they make reference to themselves, in our case the system is endogenously determined.

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# CHAPTER 7

# CONCLUSION

This dissertation offers a description, analysis and management of various risks faced by grain farmers in Northeastern Mexico. Although the geographic location of this study is very specific, most of these risks are also present in other developing countries. Many agricultural risks are common to both developed and developing countries. However, due to the financial and social infrastructure and political stability of the former, farmers in developing countries have access to different tools to deal with risk. These tools can be market based or part of government policy. Some risks specific to developing countries, unfortunately, cannot be completely hedged away; however, by understanding their nature actions can be suggested to decrease their effect.

How people perceive risk can take many dimensions: from objective, based on a probabilistic assessment, to subjective, based on fear and emotions, and a combination of both. Objective risks assessments are done through historical analysis of events or through expert opinion. For instance, environmental risks, which are one of the main causes of production variation, are assessed on historical probability of events and through modeling of future scenarios. Price risk, also a source of major concern among producers, is measured from its past values and from the possible effects of diverse policies. These risks can be hedged using market based tools like insurance products, a common practice in rich countries. Subjective risks are based on emotions and are the reactions to some stimuli. When people behavior is based on emotions, the probability of unlikely events tends to be exaggerated. In this study, for instance, farmers' fear of being victimized depends on social and demographic characteristics and not on objective assessment. People can also evaluate risk based on a combination of both objective and subjective assessments. Refraining from borrowing for fear of losing collateral despite having demand for credit (i.e. risk rationing) can be interpreted as both, an objective assessment on the probability of default and as the emotional response that the idea of losing collateral invokes. This system of decision making is based on the dual process: emotional and deliberative.

All these aspects of risk analysis are considered in this thesis.

Chapter 2 This chapter presents the results of a survey on Mexican grain farmers conducted in 2011. The importance of this survey is that it provides a summary on the conditions of these farmers as well as other information related to the current violence level caused by the war on drugs. This survey provides information on demographics, production, risk taking behavior, and risk perception on violence that was previously not known.

Chapter 3 discusses price risk faced by Mexican farmers, and also provides a market based mechanism for protecting against adverse price changes. This type of risk is based entirely on objective assessments, i.e. probability analysis. Although in developed economies agricultural price hedging mechanisms exist, due to the sophistication of their financial system compared to poor countries, this is not necessary the case for developing countries. The model created in Chapter 3 takes advantage of the price dependency of grain prices in Mexico to the futures price of yellow corn in the US. The resulting quanto options developed shows to be priced consistently with the corresponding options in the US. This model takes into account all factors affecting local prices in Mexico: futures price in the US, exchange rate and transportation costs. Moreover, this model, by providing the theoretical price for agricultural options in Mexico, can provide a reference price for use in current government programs.

Chapter 4 analyzes the characteristics for risk rationing and to provide a specific test of the risk rationing theory proposed by BCG. The prevalence of risk rationing in Mexico and a comparative analysis in China are discussed in this chapter. Risk rationing occurs when people abstain from borrowing formally for fear of losing their collateral, despite having demand for credit at the current interest rates. Risk rationed farmers prefer to stay in a low income-low risk activity, because the risk of losing collateral if they borrow is deemed to be sufficiently large.

Among all respondents, the total proportion of risk rationed, quantity rationed and price rationed farmers are approximately 6.2%, 14% and 79.9% respectively for China and 34.67%, 9.94% and 55.37% respectively for Mexico. The results verify the existence of risk rationing in both China and Mexico rural credit markets. There is a strong support to the theory that the financial poor are more likely to be quantity rationed but the financial wealthy are more likely to be risk rationed. However, productive wealth appears to have to no impact on all types of credit constraint typologies. We find that risk averse and prudent individuals are more likely to be risk rationed. This is likely due to innate risk judgments made by individuals. Our study is among the first that we are aware that has been able to provide evidence that in fact risk rationing behavior can take place in the presence of insurance markets. This evidence is not consistent with BCG, which stated that risk rationing occurs when insurance markets are absent. Combining the results, risk adverse households tend to have a higher willingness to pay for insurance and participate in insurance markets and are more likely to be risk rationed.

The elasticity of demand for credit has a strong implication for credit markets and we find that credit demand elasticities differ amongst rationing typologies. We find that a large proportion of risk rationed farmers have perfectly inelastic demand for credit but at lower interest rates even risk rationed farmers might enter the credit market.

What we have learned from studying risk rationing is that efforts to enhance the working of rural credit markets and credit access in order to increase agricultural investment and alleviate poverty must also deal with risk**.** BCG argue that failure to account for risk rationed agents, who have profitable projects but are discouraged from implementing them because of the riskiness of the available loan contracts, may lead to a distortion of the rural financial system. We agree. One policy remedy is to maintain lower interest rates since we find that risk rationed groups may enter the credit market. Such a policy is not without its critics however. In addition, BCG considers at length the role of ambiguous property rights. This is the current state of land use in China. The current debate in China regarding transferability and mortgagability of land use rights might be successful if collateral played a key role in borrowing agreements. However, land use right reform in China will be only partially effective to encourage risk rationed borrowers to enter the credit market since our results do not indicate that using land use rights for collateral can differentiate risk rationed farmers from other typologies. As a result, policies that decrease the risk associated with loan contract to rural households would be more appropriate in the presence of risk rationing.

Chapter 5 looks into a new approach in understanding risk rationing. Risk rationing is based on both objective and subjective risk assessments. Objective because farmers estimate a probability distribution to their future income under debt, and from there, they estimate the probability of default. Subjective because they may react negatively to the idea of losing collateral, and so make the decision of borrowing based on their emotions. The approach used in chapter 5 depends on the probability distribution of income and on the discount rate.

This new approach is formulated from Mason's disutility jump and the implications of the jump in the preference for skewness, which imply a large downside risk aversion. In this paper we estimated farmer's expected revenue distribution through means of simulation a Pert distribution with three parameters that we observed from a previous survey in Mexico. Using the simulated distributions' moments we performed a random utility analysis between people classified as risk rationed and price rationed. Risk rationing preference depends on expected distribution, skewness preference and on discount rate.

Following the jump disutility theory proposed by Mason, we created a model where this jump disutility refers to the collateral loss that risks rationed avoid by not entering into the formal credit market. From there we have two possible distributions of future revenue, one under debt and one without debt. A formal debt would create, or increase, a disutility jump at a given revenue threshold, which if reached, triggers the jump disutility in the form of collateral loss. Reaching the threshold level of revenue is avoided at all costs under risk rationing. On the other hand, the distribution of future revenues without debt does not have this significant disutility jump. Thereby, making that distribution less negatively skewed compared to under risk rationed. Risk rationed have a stronger preference for skewness, and their expected revenue distribution is less positively skewed, or more negatively skewed, than that of price rationed.

Through a random utility model analysis, we estimated the preferences for expected revenue moments, and for present consumption. By looking at the differences in utilities and their derivatives between credit groups, given by the coefficients of the random utility model, we estimated that risk rationed have a higher discount factor that price rationed. This suggests that risk rationing can also be explained by the preference of current consumption. Price rationed, on the other hand, sacrifices current consumption in hopes to have a larger future consumption. This is measured by the difference between utility at initial wealth level. This difference is the constant term in the regressions.

The expected revenue moments were estimated by Monte Carlo analysis. From the results of a 2011 survey of Mexican grain farmers we obtained their minimum possible, maximum possible and most likely revenue for their next season. With these three parameters we simulated a Pert distribution for each farmer. From these distributions we obtained their first three moments. These moments were used as independent variables for our random utility analysis. This approach of simulating expected distributions based on farmers' responses have not been fully exploited in the literature.

A novel approach to classifying credit rationing is also done in this study. Unlike previous research that establish risk rationing status a posteriori, here we use a survey specifically design to unambiguously classify credit rationing status (see figure 8, chapter 5). Using this method, we eliminate potential problems of endogeneity. For instance, observing no credit demand does not imply risk rationing, it can be a price rationed that does not demand credit at current interest rates, or it may be a quantity rationed person, someone who was rejected from a formal loan.

Although the analysis of risk rationing through the use of a random utility model shed lights on time preference of consumption, skewness preference, and degree of risk aversion and downside risk aversion, we believe that there are other approaches to understanding risk rationing. One approach worth exploring is the application of the Dual Process theory in risk rationing. Farmers' response to the risk of losing collateral by not borrowing needs to be examined through the interaction of emotions and calculative probabilities of default. This is a natural extension of this topic that can provide further insights on the relationship between risk preferences and emotions.

The last analysis, chapter 6, is based mostly on the emotional response to stimuli in the farmers' environment. For this, we used the approach to behavior based on the ecological psychology theory. This school of thought analyses behavior in the context of each individual's environment. This theory provides a methodology for understanding perception and action. This analysis is the first, to my knowledge, that incorporates Slovic analysis of fear perception into the ecological psychology framework. Also, it is the first to prove the existence of the axioms for an ecological psychology system. I found an indication of simultaneity between risk perception and actions. That is, our actions affect our perception of risk. My analysis was conducted in a region in Mexico that at that time was a conflict zone for two major drug cartels. Therefore, the presence of the narcos was known and fear. These fear perceptions are analyzed and also various actions taken by the farmers under our study. Although most of these farmers are not at risk from the narcos, since most of them are small scale farmers, many show fear of being victimized and had altered their daily activities in some way or another. Furthermore, demographic characteristics are found to affect fear level and perception. For instance, I found that farmers who attend religious activities regularly fear much less than those who don't. To my knowledge this is the first survey conducted in a conflict area of narcos in Mexico.

In order to understand risk, we shouldn't limit ourselves with objective assessments, but need to understand that there are more than just economic risks that dictate production behavior. It is very important to look at subjective risks as well as price and yield risks. If a producer has a high emotional response to risks, then market mechanisms may not bring the desired results. Other actions may be required to reduce risk perception, like community involvement and support.

Risk has many dimensions that have not yet been fully understand nor accepted. This thesis contributes in a small way to understanding risk as a broader concept than traditionally used. The analysis done here are not limited to agricultural risks, but can be extended to other activities as well and to the analysis of risk in general.

This paper analyses the effect of drug violence in a rural area in Mexico where this type of violence is relatively new, using the framework of the ecological psychology and dual theory process. We found various significant factors that explain fear among farmers, and how that fear is affecting rural life and production decisions.

In this analysis, using a variety of established psychometric models to determine degree of fear developed by Slovic, I was able to create through cluster analysis four groups that classify people according to their fear perception and feeling of control. These groups are labeled Optimistic, Fearful, Pessimistic and Confident. We analyze the effect of demographic and economic variables in determining group membership, and on actions/intentions in response to fear. Using a Hausman Test, we found evidence that stimuli are endogenously determined by actions.

Another interesting finding of this study is that decisions of the subjects can be explained following the Dual Process approach. This theory, although does not substitute the ecological psychology approach, clarifies the ecological framework. Dual process explains behavior under risk as the result of two decision making mechanisms: an emotional, irrational, reaction based mechanism; and a deliberated, rational, non-emotional mechanism. I was able to measure the degree of emotional response and deliberative response to risk according for each action. The emotional response to risk by each group is given by its interaction of group dummy and the degree of fear, high or low, stated in the survey. These variables provide a measure of how much a low of high fear state affect decisions by each group. The measure of deliberate response to risk is related to their probability assessments of risky events. Farmers responded to the degree of likelihood that they, or their family members, would become a victim of narco related crimes within the next 12 months. The coefficient of the probabilistic estimations of adverse events on actions provides a measure of the effect of the rational mechanism in decision making. These coefficients give the elements for decision making under the dual process model.

Dual process theory is used to measure the dominant decision process for the farmers in this study. I find that for all groups emotions have a larger effect than probability assessments of risks. This may be due because all subjects of study live under constant emotional stimuli caused by the narcos. My results suggests that fear based stimuli increases the use of the emotional decision process compared the rational system. This is analogous to results given by Schulze and Wansink (2012), in Chapter 6, on cognition overload and emotional process dominating the rational.

This paper also contributes to the application of the ecological psychology paradigm. To our knowledge this is the first study that supports the existence of an ecological environment in a social study. How we respond to the environment is determined by our perception of them. Our actions resulting from our perception of those forces alters our perception in a circular way. Our results are in accordance to the conditions under the ecological psychology framework. Our system is in the scale of perception-action, farmers respond to drug violence; they connect to the formalism of affordances, they refer to the exogenous variables in our model; they are more general than the laws of inanimate systems; and they make reference to themselves, in our case the system is endogenously determined.

This thesis provides novel approaches to risk, provides a market based option pricing mechanism novel to Mexico, and proves established theories never proven in the field. Moreover, the field study of Mexican farmers reported here is, to our knowledge, the first study on agricultural life, production and risk (on a wide spectrum) conducted in a real time narco conflict zone in Mexico. The data collected provides a snapshot of risk assessments of people living under a violent environment. These results provide some bases for new directions of study on risk perception and the decision making process. Alternatively, some results can have policy implications to farming insurance, adoption of new technology, and mitigation of fear due the stigma of narcos.

APPENDIX A

MEXICAN FARMERS' SURVEY IN ENGLISH

Mexican Farmer's Survey

## *A. Farm Characteristics and Farmer Risk Attitude*

**Date: month____, day____, year____**
**Interviewer initials:_________** **Name of Village:_________________**

1. Sex of Respondent: ________Male; ___________Female.
2. Age of Respondent: ________
3. Marital Status: Single___, Married___, Divorced___, Widowed___, Union___
4. Are you a head of the household? Yes_____, No_____
5. Do you have any children? Yes___,No___
    i. How many?_____
6. Including yourself how many people live in this house ________________
(*INTERVIEWER: this is the total number of people sharing the house of the respondent including children, parents etc.)*
    i. How many are younger than 6 years old?______
        1. How many of them are your children?______
    ii. How many are between 6 and 18 years old (age 6 and 18 inclusive)?______
        1. How many of them work______, study_______, or both________
        2. How many of them are your children?______
    iii. How many are older than 18 years old?______
        1. How many of them work______, study_______, or both________
        2. How many of them are your children?______
    iv. What is the age of the oldest and youngest person living in your house?
    Oldest______, Youngest______

7. What is your highest education level:
    a) Never went to school_____
    b) Some elementary school _____
    c) Completed elementary school_____
    d) Some middle school_____
    e) Completed middle school_____
    f) Some high school_____
    g) Completed high school _____
    h) Some university or technical school_____
    i) Completed university or technical school_____

8. Do you have a group of friends that regularly meets for social activities? (dinner, drinks, games, coffee): Yes_____,No______

9. How many times do you gather with your group of friends per month?______
    i. How large is your group gathering?_______

10. How many times do you gather for social activities with your family or relatives per month?______
    i. How large is your family and relatives gathering?_______

11. Do you belong to any social groups in your community (e.g. religious, volunteer group, clubs, etc.)? YES_____, NO_____ (this do not include any producer's association)

12. Do you consider yourself well informed about the daily events in your community or region?
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

13. Do you consider yourself a religious person?
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

14. How many times on average do you attend religious celebrations per month?________

15. What is your religion? Catholic_____, Baptist____, Pentecostal____, 7th Day Adventists____, Mormon____, Jehovah's Witness____, Other_______________(please specify)

16. How many years have you been farming? ________

17. Was your farm? Bought by you_____, Inherited_____, Given to you by a social group/government_____, Other__________
    i. **If you inherited your farm**, was it from your parents? YES___,NO____
    ii. How many generations has the farm belonged to your family?______
    (If parents bought it, then it is 2nd generation, and so on.)

18. Regarding your farm, do you?
    i. Own it alone ______
    ii. Rent it only _____
    iii. Own it in a partnership (multiple owners)____
    iv. Own and rent _______

19. What is the **total size in hectares** of your household farm excluding rented?
__________

20. Do you rent additional land for production? Yes___, No___
    i. **If Yes**, How many additional Hectares do you rent alone? ____________
    ii. How many additional hectares do you rent in a partnership?___________

21. If you rent land do you pay cash______, a fraction of the production _________, or both______?

a) If you pay cash, how much do you pay on average per Ha per Year? __________
b) If you pay by sharing production, what fraction, in percentage, do you give as payment on average per crop?_______ %

22. Does any other member of your household own or rent land for production? Yes___, No___
    i. **If Yes**, What is the total amount of land, owned and rented, used for production of all members of your family excluding yourself?_______ (this excludes any rental partnership among household member).

23. Do you live in your farm? Yes___, No___
    i. **If No**, How far do you live from your farm, or main farm?_______ Km.
    ii. How long does it take you to get to your farm, or main farm? _____ min.
24. During crop season, how many times per week did you go to your farm to check on the crop? Please fill in the boxes.

| Stage of Crop | 2009 | 2010 | 2011 |
|---|---|---|---|
| Planting | | | |
| Growing | | | |
| Harvest | | | |

25. Do you have irrigation in your farm? Yes____, No___
26. Do you use fertilizers? Yes____, No_____
27. Do you use pesticides? Yes____, No_____
28. Do you own____, part-own_____ or rent ______ tractors? (Select all that apply)
29. On average I have __________paid employees, and __________ unpaid family laborers.
30. How long, **in months,** do you hire them on average per year? Paid employees______, Unpaid_______
31. Do you have any farm loans? Yes____, No_____
    i. **If Yes**, What is the total amount? ____________
    ii. Approximately what is the percentage rate interest? ______% per month, _______% per year. (**fill only one**)

32. During rainy season I can access ________ % **(0 - 100%)** of my farm? (write a percentage)

33. In general, how would you describe the business climate, **from 1 to 5**, for farmers in your area in the following years? For 2012 please indicate your expectations. 1=extremely bad, 2= very bad, 3=bad, 4= normal, 5= good, 6= very good, 7= extremely good. (please fill in the boxes)

| 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|
| | | | |

34. If you belong to an Ejido, are you an active member in its decision making process? Yes__,No__

35. Please list the top five crops and livestock you have grown in the last 2 years and your plan for next year by the amount of land used for each crop, its yields (ton/ha) and its sales price (mxp/ ton)

| **Year** | **Rank** | **Crop/ Livestock** | **Total Land (Ha)** | **Yields (ton/ ha); Number of Heads** | **Price (mxp/ ton) or (mxp /head)** |
|---|---|---|---|---|---|
| **2009** | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | 5 | | | | |

| Year | Rank | Crop/ Livestock | Total Land (Ha) | Yields (ton/ ha); Number of Heads | Price (mxp/ ton) or (mxp /head) |
|---|---|---|---|---|---|
| 2010 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

| Year | Rank | Crop/ Livestock | Total Land (Ha) | Yields (ton/ ha); Number of Heads | Price (mxp/ ton) or (mxp /head) |
|---|---|---|---|---|---|
| 2011 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

Plan for next year:

| Year | Rank | Crop/ Livestock | Total Land (Ha) | Yields (ton/ ha); Number of Heads | Price (mxp/ ton) or (mxp /head) |
|---|---|---|---|---|---|
| 2012 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

36. Approximately how much was your **total revenue** from farming activities in the past 12 months? $_________

37. Approximately, what percentage of your total revenue comes from your farming activities? ___%

38. Do you receive Procampo subsidies? Yes_____, No_____
    - i. **If Yes**, how much did you receive from Procampo last year?___________
    - ii. Did you: **A)** farm on your Procampo subsidized land, **B)** rent your Procampo-subsidized land, or **C)** lend your Procampo-subsidized land to other farmers to farm? ________ (Write all that apply: A, B or C).

39. Do you receive any other cash subsidy besides Procampo? Yes____, No_____
    - i. Do you or any member of your household receive Progresa? Yes___, No___
        1. **If Yes**, How much did you receive from Progresa last year?_______
    - ii. How much did you receive from other cash subsidies last year?_______

40. What was the total household **revenue** in the past year from all sources including farming, government programs, part time labor, livestock, and remittances (best guess)? $________

41. What was the total household **net income/ profit** in the past year from all sources including farming, part time labor, cattle raising, and remittances (best guess)? $_____________ (This is equal to revenues (Q40) minus all expenses (rent, salaries, inputs))

42. How much do you spend on average per **month** in your household? (This includes food, school, electricity, gas) $________

43. How much do you save on average per **year**? $______

44. Please approximate the percent of your total farming income that comes from livestock ____________% (INTERVIEWER: Prod for this number. If they do not know exactly then say "we do not need an exact number just an approximate number" or "was it less or more than 50%, less than 25% etc. until a number is obtained.)

## *B. Sources of Risk and Risk Perceptions*

45. Please indicate if you are willing or not willing to take risks (**Circle** the most appropriate response).

| **Statement** | **Not Willing to Take Risk** | | **Neutral to Take risk** | | **Willin g to Take Risk** |
|---|---|---|---|---|---|
| I am willing to accept greater production risks to increase the chance of higher profits | 1 | 2 | 3 | 4 | 5 |
| I am willing to take risks with new technologies before I see good results in other farms | 1 | 2 | 3 | 4 | 5 |
| I am willing to take risks with new management practices before I see good results in other farms | 1 | 2 | 3 | 4 | 5 |

(Technologies refer to new seeds, fertilizers, etc; Management practices refer to crop rotation, forward contracts, insurance)

46. If you grow corn, sorghum or soybeans identify the lowest price **you believe** possible, the price that **you believe** is most likely to be received, and the highest possible price **you believe** possible in ***the next crop year (2011/12)***

*(INTERVIEWER: for each crop production the respondent for lowest, most likely and highest: you may say things like 'we do not need the exact numbers, just your own personal judgment about what the prices might be' by most likely price ask them what price they expect to receive in the next harvest. Note: most likely can be the same as lowest and highest)*

(Please fill in the boxes)

| **Crop** | **Lowest possible price** | **Most likely price (mxp/ton)** | **Highest possible price** |
|---|---|---|---|

| | (mxp/ ton) | | (mxp/ton) |
|---|---|---|---|
| Corn | | | |
| Sorghum | | | |
| Soybeans | | | |

47. If you grow corn, sorghum or soybeans, identify the lowest yield **you believe** possible, the yield that **you believe** is most likely to be received, and the highest possible yield **you believe** possible in ***the next crop year (2011/12).***

*(INTERVIEWER: for each crop production the respondent for lowest, most likely and highest: you may say things like 'we do not need the exact numbers, just your own personal judgment about what the yields might be' by most likely yield ask them what yield they expect to receive in the next harvest. Note: most likely can be the same as lowest and highest)*

(Please fill in the boxes)

| Crop | Lowest possible yield (ton/Ha) | Most likely yield (ton/Ha) | Highest possible yield (ton/Ha) |
|---|---|---|---|
| Corn | | | |
| Sorghum | | | |
| Soybeans | | | |

48. If you grow corn, sorghum or soybeans what is the lowest and highest yield (ton/Ha) that you recall from your years in farming? (*INTERVIEWER: if cannot recall exact year, ask how ago many years and decode year it occurred = 2011 – number of years ago)*

(Please fill in the boxes)

| Crop | Lowest historical yield (ton/Ha) | Year it occurred | Highest historical yield (ton/Ha) | Year it occurred | Average yield across year (ton/Ha) |
|---|---|---|---|---|---|
| Corn | | | | | |
| Sorghum | | | | | |
| Soybeans | | | | | |

## *C. Risk Management Options Use and Perceptions*

49. Please indicate how **important you believe** each item to be in terms of risk management in your farm. Then, mark a "**0**" if **you do not use** this to manage risk in your operation. Select: 1 = not important, 2 = less important, 3 = neutral, 4 = important, and 5 = very important (**Circle** the most appropriate response).

Circle from 1 – 5 even if you don't use the option to manage risk.

| ***Risk Management Options*** | **0 if not used** | **Not Important** | | | | **Very Important** |
|---|---|---|---|---|---|---|
| More than one crop, animal, or farm | 0 | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| diversification | | | | | | |
| Fields or farms in different locations (geographic diversification) | 0 | 1 | 2 | 3 | 4 | 5 |
| Irrigation | 0 | 1 | 2 | 3 | 4 | 5 |
| Spreading sales: selling each product over a period of time rather than all at once (diversified marketing) | 0 | 1 | 2 | 3 | 4 | 5 |
| Using contracts to market your crop in advance at a fixed price | 0 | 1 | 2 | 3 | 4 | 5 |
| Government programs | 0 | 1 | 2 | 3 | 4 | 5 |
| Maintaining financial reserves: having cash and readily convertible assets(e.g. machineries, livestock) | 0 | 1 | 2 | 3 | 4 | 5 |
| Investing off-farm for other sources of income | 0 | 1 | 2 | 3 | 4 | 5 |
| Working off-farm | 0 | 1 | 2 | 3 | 4 | 5 |

50.
51.
52. When I choose what crops to grow, I base my decision on: (Please circle the appropriate number from 1 - 5).

| | Not a factor | | | | Very Important factor |
|---|---|---|---|---|---|
| The current price of the crop | 1 | 2 | 3 | 4 | 5 |
| The variability in price | 1 | 2 | 3 | 4 | 5 |
| Average yield per Ha | 1 | 2 | 3 | 4 | 5 |
| The variability in yield per Ha | 1 | 2 | 3 | 4 | 5 |
| The average cost per Ha | 1 | 2 | 3 | 4 | 5 |
| The variability in cost per Ha | 1 | 2 | 3 | 4 | 5 |
| The degree of violence in the area | 1 | 2 | 3 | 4 | 5 |

## *D. Crop Insurance Use and Perceptions*

*INTERVIEWER: Crop insurance is a common tool used by Americans farmers. Crop insurance will pay you if your crop yield falls below some percentage of your* ***average yields****. For example if your average* *yield is 2 ton/ha for a particular crop, insurance may provide a payment if actual crop yield falls below this average. For example if actual yield is 1ton/ha then you would receive a payment based on the difference between 2 ton and 1ton (=1 ton) times the average harvest price. If the price is $2,000/ ton then you would receive $2,000*(2-1) = $2,000 but if yields are above 2 ton/ha you receive nothing from the insurer.*

53. Is crop insurance currently available to you?

Yes_____ , No_____ (if No, skip to Q56)

54. (***If answer to Q53 is Yes***) Do you purchase crop insurance?

Yes_____ , No_____ (if No, skip to Q57)

55. (***If answer to Q53 is Yes***) List crops covered. How much do you pay per Ha?

| Crop covered | Insurance premium (mxp/ Ha) |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

56. (***If answer to Q53 is No***) If crop insurance were offered to you, do you think that you would purchase it? Yes_____, No_____

57. If you grow corn, sorghum or soybean, which do you believe has a higher chance of a significant yield loss next year: **Corn**________, **Sorghum**_______, **Soybean**_______?

(**Only one can be selected**. If only one crop is grown select that crop)

Please select Q58, 59 or 60 based on the crop you chose in Q57)

58. (**If Selected CORN in Q57**) Imagine a crop insurance product that would guarantee that your **revenue per ha never falls below $6,500/ha for Corn**. Taking into account all past crop yields, and what you believe about next year's crop yield,

a) Would you be willing to pay **$1,470 /ha** to guarantee a minimum of **$9,800/ha**.?
Definitely buy__ ,Might buy ___ ,Would unlikely buy ___ ,Definitely would not buy_____

b) Would you be willing to pay **$785 /ha** to guarantee a minimum of **$9,800/ha**?
Definitely buy__ ,Might buy ___ ,Would unlikely buy ___ ,Definitely would not buy_____

c) Would you be willing to pay **$295 /ha** to guarantee a minimum of **$9,800/ha**?
Definitely buy__ ,Might buy ___ ,Would unlikely buy ___ ,Definitely would not buy_____

d) Would you be willing to pay **$50/ha** to guarantee a minimum of **$9,800/ha**?
Definitely buy__ ,Might buy ___ ,Would unlikely buy ___ ,Definitely would not buy_____

59. (**If Selected SORGHUM in Q57**)Imagine a crop insurance product that would guarantee that your revenue per ha on (***for crop indicated in Q56***) never falls **below $6,500/ha for Corn**. Taking into account all past crop yields, and what you believe about next year's crop yield,

e) Would you be willing to pay **$975 /ha** to guarantee a minimum of **$6,500/ha**.?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

f) Would you be willing to pay **$520 /ha** to guarantee a minimum of **$6,500/ha**?

Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

g) Would you be willing to pay **$195 /ha** to guarantee a minimum of **$6,500/ha**?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

h) Would you be willing to pay **$32/ha** to guarantee a minimum of **$6,500/ha**?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

60. (**If Selected SOYBEANS in Q57**)Imagine a crop insurance product that would guarantee that your revenue per ha on (***for crop indicated in Q56***) never falls **below $8,600/ha for Corn**. Taking into account all past crop yields, and what you believe about next year's crop yield,

i) Would you be willing to pay **$1,290 /ha** to guarantee a minimum of **$8,600/ha**.?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

j) Would you be willing to pay **$670 /ha** to guarantee a minimum of **$8,600/ha**?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

k) Would you be willing to pay **$260 /ha** to guarantee a minimum of **$8,600/ha**?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

l) Would you be willing to pay **$43/ha** to guarantee a minimum of **$8,600/ha**?
Definitely Buy___ Might Buy ___ Would Unlikely Buy ____ Definitely would not buy_____

Considering all aspects of the household including the farm, operations, house, contents, automobiles, machinery and equipment do you regularly purchase insurance for any of the following items (*Leave blank if not applicable*):

a. Life Insurance Yes_____ No____
b. Fire insurance for home and contents Yes_____ No____
c. Automobile Insurance Yes_____ No____
d. Health/Medical Insurance (not social sec) Yes_____ No____
e. Protection against crop loss (crop insurance) Yes_____ No____
f. Protection against livestock loss (livestock insurance) Yes_____ No____
g. Other ______________________________________________

61. Imagine a new loan product that had a built-in insurance mechanism so that when a severe drought occurs, the amount of debt you have to repay decreases as the intensity of the drought increases. Would you be interested in such a loan product even if it required an increased interest rate? For instance, if your harvest is lost due to a drought you will not need to repay your loan.

a) Not at all interested_____, b) Moderately interested______, c) Very Interested_____

~~62.~~
~~63.~~

### *E. Farm Finance and Risk Management*

64. Do you have any debt outstanding? Yes____, No _____

a. **IF YES,** please indicate the total amount of money you owe $___________
b. Please indicate the total amount of money that you owe and the interest rate being charged from:

| | Loan Amount $ | Annual Interest Rate % |
|---|---|---|
| a.Friends | | |
| b.Relatives | | |
| c.Formal Lenders (Financial Instit.) | | |
| d.Money Lenders/ Pawn Shop | | |
| e.Government loans | | |
| f.Grain Buyer | | |
| g. Input Suppliers | | |
| h.Other | | |

65. If you sell all your assets (home, land, livestock, agricultural produce, etc.) how much will you estimate to get? $_____________________.

66. Regarding to your current total amount of debts, assets and productivity, what do you think about your debt level? (Circle one)
1) very low 2) low 3) adequate 4) high 5) very high

2) Have you ever been denied a loan by the Government, bank or other financial institutions? Yes____, No____

a. **If YES,** what are the major reasons you were denied credit?
(Answer more than one if necessary)
i. insufficient collateral ___________
ii. Main source of income subject to too much price risk _________
iii. I have failed to repay a loan in the past __________
iv. Bank does not believe I am trustworthy ___________
v. The repayment schedule required by the bank / lender does not match the timing of sales from my small business ________

67. Have you been able to obtain **as much credit as you need** from banks/ lenders? (Circle only one)
i. Never _________________________
ii. Sometimes ______________________
**if selected ii**., Approximately what percentage of loans that you asked for were provided in the full amount that you requested? ___________%
iii. Always _________________________

68. Have you ever **been late** in repaying a loan? (INTERVIEWER: By 'being late' we mean that payment was not promptly paid as agreed upon by the lender, but payment was eventually made.)

a. Relative YES_____ NO______
b. Friend YES_____ NO______
c. Money Lender YES_____ NO______
d. Government YES_____ NO______
e. Grain buyers YES_____ NO______
f. Input Suppliers YES_____ NO______
g. Commercial Bank YES_____ NO______
h. Other YES_____ NO______

69. Have you ever **defaulted** on a loan? (INTERVIEWER: By defaulting we mean that loan was **NEVER repaid** as agreed upon by the lender)

a. Relative Yes_____, No______
b. Friend Yes_____, No______
c. Money Lender Yes_____, No______
d. Government Yes_____, No______
e. Grain buyers Yes_____, No______
f. Input Suppliers Yes_____, No______
g. Commercial Bank Yes_____, No______
h. Other Yes_____, No______

70. In your region, which of these two statements is most correct?

A) Grain buyers or banks evaluates my creditworthiness and **offers me a loan** or credit card without me requesting it. TRUE___________, FALSE__________

B) I must formally **request a loan** from my buyer or bank: TRUE______, FALSE______
(Surveyor: *Q70* A and B are mutually exclusive: If one is False the other is True)

IF *Q70 B* is TRUE skip to *Q77*

71. (***if answer to Q70 A is TRUE***) On the most recent loan of credit card OFFER, approximately how much did your buyer or Bank OFFER to lend you?$__________ (credit card limit or loan offer)

72. Of the amount offered in ***Q71***, how much of loan (mxp) did you ACTUALLY use? (Do not leave blank. put 0 if no loan was used, If don't know put 9999)________________

73. (***If answer to Q72 is greater than zero***) What are the purposes of loan in ***Q72*** that you ACTUALLY used (answer more than one if necessary)?

a. Agricultural production Yes_____ No____
b. House construction/renovation Yes_____ No____
c. Purchase of car/motorcycle/bicycle Yes_____ No____
d. Household consumption Yes_____ No____
e. Medical expenses Yes_____ No____
f. Education expenses Yes_____ No____
g. Other?_______

74. Is the amount of loan you used in ***Q72*** less than, equal to or more than the amount that you ACTUALLY NEEDED for the purpose stated in ***Q73***? (INTERVIEWER: remind the respondent of answer to ***Q72***)
Less than _____ Equal to ______ More than _______

75. (***If answer to Q72 is less than Q71***) If the amount **you actually borrowed** was less than the amount that the lender was willing to provide you, what do you believe are the major reasons you ***did not use*** the total amount of credit made available to you (answer more than one if necessary)?

a. I do not need loan/ I do not invest Yes_____ No____
b. I have own money and saving to invest Yes_____ No____

c. I borrowed from friends Yes_____ No____
d. Interest rate is too high Yes_____ No____
e. I am afraid of losing collateral Yes_____ No____
f. I am not credit worthy Yes_____ No____
g. I cannot get a guarantee Yes_____ No____
h. Loan products are not flexible enough to meet my ability to repay Yes_____ No____
i. Other Yes_____ No____

76. Do you think you have **sufficient collateral** to secure a higher loan amount than you identified in ***Q71***? Yes______ No______

SKIP TO Q89

77. (***If answer to Q70 B is TRUE***) Have you applied for a loan from your buyer or bank within the past 2 years? Yes____, No_______(**If No, skip to *Q86***)

78. (***If answer to Q77 is YES***) On the **most recent loan request** approximately how much loan did you request? $_______

79. How much money did your grain buyer or bank **offer you?** $_________ (zero if loan fully denied)

80. (***If answer to Q79 is greater than zero***) Did you accept the offered loan? Yes______ No_______(**If No, skip to *Q83***)

81. (***If answer to Q80 is Yes***) For what purposes you used the offered loan (answer more than one if necessary)?

a. Agricultural production Yes_____ No____
b. House construction/renovation Yes_____ No____
c. Purchase of car/motorcycle/bicycle Yes_____ No____
d. Household consumption Yes_____ No____
e. Medical expenses Yes_____ No____
f. Education expenses Yes_____ No____
g. Other Yes_____ No____

82. Is the amount of loan you received in ***Q79*** less than, equal to or more than the amount that you ACTUALLY NEEDED for the purpose stated in *Q78*? (INTERVIWER: remind the respondent of answer to ***Q79***)
Less than _____ , Equal to ______, More than _______

83. (***If answer to Q80 is No***) Why didn't you accept the offered loan (answer more than one if necessary)?

a. The amount of offered loan is too little for what I planned to invest Yes_____ No____
b. I borrowed from friends instead Yes_____ No____
c. Interest rate is too high Yes_____ No____
d. I am afraid of losing collateral Yes_____ No____
e. Loan products are not flexible enough to meet my ability to repay Yes_____ No____
f. Other Yes_____ No____

84. Do you think you have sufficient collateral to secure a higher loan amount than you identified in ***Q79***? Yes______, No______

85. (***If your answer to Q78 is less than Q79***) what do you believe are the major reasons you were denied your partial or full credit request (answer more than one if necessary)?

| Reasons | Very Likely | Moderately likely | Likely | Not likely | Not very likely |
|---|---|---|---|---|---|
| a. Insufficient collateral | | | | | |
| b.Crops/Livestock subject to too much price risk | | | | | |
| c.Subject to too much yield risk | | | | | |
| d.The crop grown are vulnerable to the extreme weather | | | | | |
| e.I have failed to repay the loan in the past | | | | | |
| f.Bank does not believe I am trustworthy | | | | | |
| g.My bank doesn't believe that I earned enough income | | | | | |
| h.The repayment schedule required by RCC does not match the timing of sales from my farm | | | | | |
| i.Could not find someone to guarantee loan | | | | | |
| j.Other | | | | | |

SKIP TO Q89

86. (***If answer to Q77 is No***) Why you have not applied for loan from your buyer or bank in the last 2 years (answer more than one if necessary)?

a. I do not need loan/ I do not invest Yes_____ No____
b. I have own money and saving to invest Yes_____ No____
c. I borrowed from friends Yes_____ No____
d. Interest rate is too high Yes_____ No____
e. I am afraid of losing collateral Yes_____ No____
f. I am not a credit worthy Yes_____ No____
g. I cannot get a guarantee Yes_____ No____
h. Loan products are not flexible enough to meet my ability to repay Yes_____ No____
i. Other Yes_____ No____

87. Do you believe you have **sufficient collateral** to obtain adequate farm credit?
Yes ________, No ________, Not sure ________

88. ***(If answer to Q84 is No or Not sure)*** assuming that you had sufficient collateral to secure any amount of loan that you need to borrow. Would you borrow more?
Yes ________, No ________, Not sure ________

CONTINUE TO Q89

89. When I make a decision of whether to borrow and how much to borrow, I consider the following: (Select only one option from each statement).

a. I cannot risk losing my business.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

b. I cannot risk not sending my kids to school.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

c. I cannot risk not having enough money to buy food.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

d. I cannot risk not having enough money for medical expenses.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

e. I cannot risk not having a place to live.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

f. I cannot risk not having enough money when I am retired/old.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

g. I cannot risk losing a chance for future credit.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

h. I cannot risk losing my social reputation within the village.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

i. I cannot risk not having enough savings to cover collateral losses.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

j. I am old and I want to live securely.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

k. I do not have skill outside off-farming.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

90. (***If answer to Q75 (g) OR Q86 (g) is Yes***) If you could get guarantee, would you apply for loan? Yes ____, No ____

---

91. Are you currently considered a "Credit Worthy" borrower by your local bank or grain buyer? YES____,NO____ (e.g. have you received unsolicited credit cards or being offered line of credit)

92. How much do you currently owe to grain buyers or banks? $ __________

93. Suppose that the current bank rate of interest is 20% per year. Assume that you can borrow as much as you need at this interest rate so that all of you credit needs are satisfied, if interest rates changed from 20% to the following rate, you would

| Monthly interest rate % | Annual interest rate % | Definitely Borrow a lot more (Yes) | Definitely Borrow some | Maybe borrow some | Maybe borrow a little | Definitely would not borrow (No) |
|---|---|---|---|---|---|---|
| 0.42% | 5 % | 1 | 2 | 3 | 4 | 5 |
| 1.25% | 15 % | 1 | 2 | 3 | 4 | 5 |
| 2.08% | 25 % | 1 | 2 | 3 | 4 | 5 |
| **2.92%** | **35%** | 1 | 2 | 3 | 4 | 5 |
| 3.75% | 45 % | 1 | 2 | 3 | 4 | 5 |
| 4.58% | 55 % | 1 | 2 | 3 | 4 | 5 |
| 5.83% | 70 % | 1 | 2 | 3 | 4 | 5 |
| 7.50% | 90 % | 1 | 2 | 3 | 4 | 5 |

94. If I ***could borrow more*** from my lender than I am currently borrowing at the ***same interest rate*** I would be more likely to borrow from my lender.
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree ____

95. I would be willing to ***pay more than the current interest rate*** in order to ***obtain loan larger than my Bank or buyer currently provides***.
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree ____

96. If ***interest rates were lower than current interest rates*** I would be more likely to borrow from a lender.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

97. If ***the cost*** of obtaining a loan (fees, non-interest charges) on buyers and bank loans were lower than current costs I would be more likely to borrow from a bank or a buyer.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

98. Have you ever been late in repaying a loan to the following lender? (INTERVIEWER: By ‘being late’ we mean that payment was not promptly paid as agreed upon by the lender, **but payment was eventually made**)

| | Yes | No |
|---|---|---|
| a.Friends, | | |
| b.Relatives | | |
| c.Formal Lenders (Financial Instit.) | | |
| d.Suppliers/ Grain Buyers | | |
| e.Money Lenders/ Pawn Shop | | |
| f.Cooperative | | |
| g.Other | | |

99. Have you ever defaulted (that is not repaid) on a loan from the following lender? (INTERVIEWER: By defaulting we mean that the **loan was NEVER fully repaid** as agreed upon by the lender)

| | Yes | No |
|---|---|---|
| a.Friends, | | |
| b.Relatives | | |
| c.Formal Lenders (Fin. Instit) | | |
| d.Suppliers/ Grain Buyers | | |
| e.Money Lenders/ Pawn Shop | | |
| f.Cooperative | | |
| g.Other | | |

INTERVIEWER: *Now I would like to ask you some questions about the saving and borrowing environment.*

100. What proportion of Household income are you able to save in a year?
a) None b) Less than 5% c) Between 5 and 10% d) More than 10%

101. What are the purposes of your savings (answer more than one if necessary)?

a. I save because I have nothing to spend money on
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

b. I save to buy a house.
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

c. I save to purchase automobile
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

d. I save in case my automobile break down
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

e. I save for traveling/leisure expenses
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

f. I use my saving for future off-farm investment
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

g. I want to make sure that savings cover my loan
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

h. I save for unexpected medical emergency
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

i. I save to send kids to school/university
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

j. I save for child marriage
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

k. I save to take care of my parents
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

l. I save to protect job loss
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

m. I save for unanticipated crop loss
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

n. I save to have ransom money
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

o. Other______________________________
Strongly Agree____ Moderately Agree_____ Agree_____ Disagree_____ Strongly Disagree _____

102. In your opinion, do you think saving is important?
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

103.
(a) I have any apprehension of obtaining a loan from a Bank or Buyers
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

(b) I have unpaid debts on previous loans from bank or buyers.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

(c) Interest rates on buyers or bank loans are higher than interest rates on loans from friends or relatives.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

(d) Interest rates on buyers or bank loans are higher than I am able to pay.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

(e) I would ***prefer*** to borrow from a friend or relative.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

(f) I do not like to be indebted to a bank or buyers.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

## *F. Credit Rationing Impact*

***Please answer the following questions. Interviewer here we use the term 'borrowing constraint'. By borrowing constraint we mean that the farmer cannot obtain all of the funds requested from a buyer or bank in the amounts or time frame required.***

104. If I faced a borrowing constraint I would use less input than is required for maximizing farm income.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

105. If I faced a borrowing constraint I would need wages from off-farm employment.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

106. If I faced a borrowing constraint I would not be able to provide a strong education and adequate health care for my children.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

107. If I faced a borrowing constraint my family members (including me) would not be able to get adequate food throughout the year.
Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

108. If I could get adequate credit as much credit as I needed from a bank or buyer, I would be more likely to (choose YES only one)

a) leave agriculture and start a non-farm enterprise Yes_____ No____
b) leave agriculture and work as off-farm labor Yes_____ No____
c) Remain in agriculture and expand agricultural production Yes_____ No____
d) Remain in agriculture and also start a non farm business Yes_____ No____
e) None of the above Yes_____
No____

109. I would prefer getting a loan at ***very low interest*** rate rather than ***borrow from relative.***

Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

110. I would prefer getting a loan at the ***current market interest*** rate rather than ***borrow from a relative.***

Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

111. I would prefer getting a loan at ***very low interest*** rate rather than ***borrow from a friend.***

Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

112. I would prefer getting a loan at the ***current market interest*** rate rather than ***borrow from a friend.***

Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

## *G. Land Use Rights*

113. On average what is the price of a hectare in good conditions in your region? $_____

114. We would like to turn our attention to the news media and learn about sources of communication in your community. Please indicate **how reliable you think** each source of information is by marking your answer.

| | **Source of Information** | **(Please circle your answer)** | | | | |
|---|---|---|---|---|---|---|
| 1 | Newspaper……………....………. | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 2 | Tv/radio ……. …………………. | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 3 | Internet…………. ….…………. | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 4 | Family member ……………..……. | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 5 | Friend……..………………… | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 6 | Local government official … | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 7 | Local university/college……… | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |
| 8 | Village/local lender…………… | Not Reliable | Slightly Reliable | Reliable | Quite Reliable | Very Reliable |

## *H. Risk Perceptions and Risk Motives*

115. "Imagine an honest stranger comes up to you and offers a gamble with the payout depending on the flip of a coin. If the coin lands heads you get the amount in the first column and if it lands tails you get the amount in the second column. Each has a 50% chance of occurring. If the gamble was repeated by many flips of the coin you would expect to receive the amount in the third column. While the odds of receiving the amount in the first column are the same as the odds in the second column the high and low values are different. **Study the six gambles in the table and select the one gamble that you would prefer**".__________

| Choice | Gain in Good luck: 50% chance | Gain in Bad luck: 50% chance | Expected value: |
|---|---|---|---|
| 1 | 500 | 500 | 500 |
| 2 | 950 | 450 | 700 |
| 3 | 1200 | 400 | 800 |
| 4 | 1500 | 300 | 900 |
| 5 | 1900 | 100 | 1000 |
| 6 | 2000 | 0 | 1000 |

The following questions are voluntary. It would help to understand your situation by asking about important events that may have occurred in your life recently.

116.
117.
118.
119. In your house, is there a family member (within past 3 years) getting divorce?
Yes_____, No_____

120. In your house, have you experienced (within past 3 years) death of a family member?
Yes_____, No_____

## *I. Perception of Insecurity*

121. Are you aware of the country's current Drug War?
Yes ________, No ________, Not sure ________

122. How safe do you think it is to live in your town / city?

| Very safe | Completely safe | Somewhat safe | Not very safe | Not safe at all |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

123. How concern are you regarding crime in your town?

| Not concerned at all | Not much | Little concerned | A lot | A great deal |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

124. How concern are you regarding crime in your roads and highways?

| Not concerned at all | Not much | Little concerned | A lot | A great deal |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

125. How much do you feel crime in your community has changed with respect to 2010?

| Crime has decreased a lot | Crime has decreased a little | Remains the same | Crime has increased a little | Crime has increased a lot |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

126. How do you rate the **level of violence in your town / city** during the following years:

| Year | Very Low | Low | Normal | High | Very High |
|---|---|---|---|---|---|
| 2010 | | | | | |
| 2009 | | | | | |
| 2008 | | | | | |

127. How much do you feel crime in **your roads / highways** has changed with respect to 2010?

| Crime has decreased a lot | Crime has decreased a little | Remains the same | Crime has increased a little | Crime has increased a lot |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

128. How do you rate **the level of violence in your roads / highways** during the following years:

| Year | Very Low | Low | Normal | High | Very High |
|---|---|---|---|---|---|
| 2010 | | | | | |
| 2009 | | | | | |
| 2008 | | | | | |

129. How confident are you that the **County/State Police** can respond and control a violent act by the criminals?

| Not at all confident | Not very confident | Somewhat confident | Very confident | Completely confident |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

130. How confident are you that the **Mexican Army and Navy** can respond and control a violent act by the criminals?

| Not at all confident | Not very confident | Somewhat confident | Very confident | Completely confident |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

131. Have you or do you know anybody that has been a victim of a violent crime within the last year? Yes____, No___ ; **If YES**, please select from the table the type of crime and whether it involved **physical violence**.

| | **Carjack** | | **Armed Robbery** | | **Kidnap** | | **Extortion** | | **Homicide** |
|---|---|---|---|---|---|---|---|---|---|
| | Violence | Non-Violence | Violence | Non-Violence | Violence | Non-Violence | Violence | Non-Violence | |
| Acquaintance | | | | | | | | | |
| Friend | | | | | | | | | |
| Relative | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Family | | | | | | | | | |
| Self | | | | | | | | | ----------- |

132. How concerned are you about you and your family's safety?

| Not concerned at all | Not much | Little concerned | A lot | A great deal |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

133. Do you feel that you or your family can become a victim of the followings crimes in the next 12 months?

| | Not at all likely | Not very likely | Somewhat likely | Very likely | Extremely likely |
|---|---|---|---|---|---|
| Homicide | | | | | |
| Kidnapping | | | | | |
| Extortion | | | | | |
| Armed Robbery | | | | | |
| Carjack | | | | | |
| Beating | | | | | |

134. How much do you **dread your family** being the victim of the following crimes in the next 12 months?

| | Not at all afraid | Not very afraid | Somewhat afraid | Very afraid | Extremely afraid |
|---|---|---|---|---|---|
| Homicide | | | | | |
| Kidnapping | | | | | |
| Extortion | | | | | |
| Armed Robbery | | | | | |
| Carjack | | | | | |
| Beating | | | | | |

135. How much do **you dread** being the victim of the following crimes in the next 12 months?

| | Not at all afraid | Not very afraid | Somewhat afraid | Very afraid | Extremely afraid |
|---|---|---|---|---|---|
| Homicide | | | | | |
| Kidnapping | | | | | |
| Extortion | | | | | |
| Armed Robbery | | | | | |
| Carjack | | | | | |
| Beating | | | | | |

136. Do you feel that **you or your family** is at a greater risk of being a victim of a violent crime than **other families in your town / city**?

| Not at all | Not much higher | About the same | Higher | Much higher risk |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

137. Compared to the rest of the families in your town, do you feel that your family is perceived ?

| | Much less | A little less | About the same | A little more | Much more |
|---|---|---|---|---|---|
| Wealthy (land) | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Vulnerable | | | | | |
| Socially Active | | | | | |
| Having Liquid Assets (cash) | | | | | |

I'm going to read to you some statements concerning narco violence. Please indicate how much you agree or disagree with each statement. **The responses are from 1 to 5: 1= strongly disagree, 2= somewhat disagree, 3= somewhat agree, 4= strongly agree**.
*INTERVIEWER: IF THE PERSON DOESN'T KNOW OR REFUSES TO ANSWER PLEASE STATE IT.*

138. If I am stopped by a narco, it is certain that I will die._______
139. There are things that I can do in order to avoid being killed by narcos.________
140. If I am being extorted by a narco, I can sell my farm and move to a different town to build a new farm.________
141. A deliberated shooting by the narcos in town can kill many people._______
142. Living in a region where narco crime is common is a new type of risk to me._______
143. The Mexican Army can identify where narcos are located.________
144. I know a lot about the modus operandi of the narcos._______
145. The crimes from widespread activities of narcos can be controlled._______
146. The presence of narcos in my region can threaten future generations.________
147. Since I work at the farm, I am personally at risk by the presence of narcos in my region.______
148. Since I transit on the local roads, I am personally at risk by the presence of narcos in my region.______
149. Widespread presence of the narcos in the country can cause a national catastrophe._____
150. When narcos commit violent crimes, the Mexican Army can react quickly to prevent further damage.______
151. The risk of me being kidnap by narcos is increasing.________
152. The risk of me being kidnap by narcos can be easily reduced.________
153. The risk of me being carjacked by narcos is increasing.________
154. The risk of me being carjacked by narcos can be easily reduced.________
155. I can minimize the risk of being a victim of narco crime.________
156. Have you consider moving to a different town because of the risk of being a victim of violent crime?

| Never | A few times | Sometimes | Many times | All the time |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

157. Do you know anybody that has moved to a different town / city because of the fear of being victimized by the narcos? Yes____, No_____
    i. **If YES**, what is your relation with them? Acquaintance______, Friend______, Relative______, Family_____

158. Have you changed your **farming decisions** because of the risk of violence? Yes___ , No____

159. Have you changed your daily activities because of the risk of violence? Yes____, No___
160. If the current level of violence continues, will you change your **farming decisions**? Yes___, No___
161. Please rank how much your **farming decisions** are affected by the following factors:

| | Not Important | | | Neither | | | Extremely important |
|---|---|---|---|---|---|---|---|
| Drought | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Hurricanes | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Crop Price | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Input Prices | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Government Programs | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Yields | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Narco Violence | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Carjack | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

***To be answered by interviewer only***

a) In your opinion the respondent was engaged in this survey and answered truthfully all questions***?***

Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

b) In your opinion the quality of answers provided in this survey is adequate to include in any written reports.

Strongly Agree ___ Moderately Agree ___ Agree ____ Disagree ____ Strongly Disagree ____

Please make any other relevant comments here:

APPENDIX B

MEXICAN FARMERS' SURVEY IN SPANISH

Encuesta a Productores Agropecuarios

### *A. Características Agrícolas y Actitud ante el Riesgo*

**Fecha: mes____, día_____, año____**
**Clave del Entrevistador:________** **Nombre del Ejido__________________**

1. Sexo del Entrevistado: 1) Masculino ________, 2) Femenino_______
2. Edad: ________
3. Estado civil: 1)Soltero___, 2)Casado___, 3)Divorciado___, 4)Viudo___, 5)Union Libre___
4. Es usted jefe de familia? Sí_____, No_____
5. ¿Tiene hijos? A) 1. Si___, 2. No___ ; B) ¿Cuántos?_____
6. Incluyéndose a usted mismo ¿Cuántas personas viven en su casa?_________ *(este es el número total de personas que comparten la casa del entrevistado, incluidos niños, padres, etc)*
   A) ¿Cuántos son menores de 6 años de edad ?______; 1. ¿Cuántos de ellos son sus hijos ?____
   B) ¿Cuántos son entre 6 y 18 años de edad (incluyen 6 y 18 años de edad)?______;
      1. ¿Cuántos de ellos son sus hijos ?______
      2. ¿Cuántos de ellos trabajan____, estudian____, ambos___
   C) ¿Cuántos son mayores de 18 años de edad ?______
      1. ¿Cuántos de ellos son sus hijos ?______
      2. ¿Cuántos de ellos trabajan___, estudian____, ambos?___
   D) ¿Cuáles son las edades de las personas más grande y más joven que viven en su casa?
      1. Más grande______, 2. Más joven______
7. ¿Cuál es su nivel de educación más alto? (Seleccione solo una opción):

   a. Nunca fue a la escuela_____ 0
   b. Cursó algo de escuela primaria _____ 1
   c. Terminó la escuela primaria _____ 2
   d. Cursó algo de escuela secundaria _____ 3
   e. Terminó la escuela secundaria _____ 4
   f. Cursó algo de bachillerato_____ 5
   g. Terminó el bachillerato_____ 6
   h. Cursó algo de escuela tecnológica o universidad_____ 7
   i. Terminó la escuela tecnológica o universidad _____ 8

8. ¿Tiene algún grupo de amigos con el cual se reúne regularmente para actividades sociales? (Comida, bebidas, juegos, café): Sí_____, No_____
9. **Conteste si respondió Sí en P8,** A) ¿Cuántas veces se reúne con su grupo de amigos al mes ?______ ; B) ¿Qué tan grande es su grupo de amigos?_______
10. A) ¿Cuántas veces al mes, se reúne para actividades sociales con su familia o parientes ?______ ; B) ¿Qué tan grandes son sus reuniones con su familia o parientes?_______
11. ¿Usted pertenece a algún grupo social en su comunidad (por ejemplo, religioso, grupo de voluntarios, clubes, etc.)? Si_____, No_____ (esto no incluye alguna asociación de productores)
12. ¿Usted se considera bien informado sobre los acontecimientos diarios en su comunidad o región? (seleccione solo una):

1) Total desacuerdo____,   2) Poco de acuerdo___,   3) Más o menos de acuerdo_____,
4) De Acuerdo___, 5) Totalmente de acuerdo_____

13. ¿Se considera usted una persona religiosa?
1) Total desacuerdo____,   2) Poco de acuerdo___,   3) Más o menos de acuerdo_____,
4) De Acuerdo___, 5) Totalmente de acuerdo_____

14. ¿Cuántas veces en promedio asiste usted a celebraciones religiosas al mes? __

15. ¿Cuál es su religión? 1).Católica_____, 2).Bautista____, 3).Pentecostal____, 4). Mormón____,
4). Adventistas del 7 º día____, 6). Testigo de Jehová____, 7). Otro_____________ (especificar)

16. ¿Durante cuántos años se ha dedicado a la agricultura? ________

17. Su predio: 1). Fue comprado por usted _____, 2). Heredado_____, 3). Asignado por un grupo social o por el gobierno_____, 4). Otro__________

A) **Si usted heredó su predio,** ¿Era de sus padres? SI___, NO____
B) ¿Cuantas generaciones ha pertenecido el predio a su familia?____ (Si los padres lo compraron, entonces es de 2 ª generación, y así sucesivamente.)

18. En cuanto a su predio, Usted : (seleccione solo una opción)
    1. Es propietario único ______
    2. No es propietario pero renta tierra____
    3. Es propietario en asociación (varios propietarios )____
    4. Es propietario y renta tierra _______

19. ¿Cuál es el **tamaño total en hectáreas** de la finca, o fincas, de su propiedad excluyendo lo rentado? ______________

20. ¿Usted renta tierra adicional a la suya para producción? Si___, No___
A) **En caso afirmativo,** ¿Cuántas hectáreas adicionales renta usted solo?_________

B) ¿Cuántas hectáreas adicionales renta en sociedad?_____________

21. Si usted renta tierra, ¿Paga un precio por hectárea 1) ______, una fracción de la producción 2)______, o ambos 3) ______? (Seleccione solo uno) A). **Si paga en efectivo**, ¿cuánto paga en promedio por hectárea al año? $________ B). **Si usted paga con parte de la producción**, ¿Qué fracción, en porcentaje, da al propietario como pago por la renta?_______%

22. ¿Algún otro miembro de su hogar es propietario o renta tierra para la producción? Si___, No___
A). **En caso afirmativo,** ¿Cuál es la cantidad **total de tierra en ha**, en propiedad o arrendamiento, que se utiliza para la producción por todos los miembros de su familia **excepto a usted mismo**? ___

23. ¿Vive usted en su finca? Si___, No___

A). **Si no,** ¿A qué distancia vive usted de su finca, o finca principal, en kilómetros?_______Km.
B). ¿Cuánto tiempo le toma llegar a su finca, o finca principal? _____ Min.

24. Durante la temporada agrícola, ¿cuántas veces por semana fue a su finca para verificar la siembra? (Por favor, rellene los cuadros)

| Etapa de la producción | 2009 | 2010 | 2011 |
|---|---|---|---|
| A)Preparación y Siembra | | | |
| B)Crecimiento | | | |
| C)Cosecha | | | |

25. ¿Cuenta con riego en su finca? Si____, No___

26. ¿Usa usted fertilizantes? Si____, No_____

27. ¿Usa usted plaguicidas? Si____, No_____

28. ¿Es usted propietario único 1)____, Propietario parcial 2)_____ ,o renta3) ______ tractores agrícolas? (Seleccione todas las que correspondan).

29. En promedio, tengo _________ empleados pagados, y ________ trabajadores familiares no remunerados. (Por favor escriba un número en cada espacio).

30. ¿Aproximadamente por cuánto tiempo, **en meses,** los contrata en promedio por año? empleados pagados ______, trabajadores familiares no remunerados _______ (Escriba el número aproximado en meses que los emplea)
31. ¿Tiene algún préstamo agrícola? Si____, No_____

    A) **En caso afirmativo,** ¿Cuál es el monto total aproximado? ________

    B) Aproximadamente, ¿Cuál es la tasa de interés porcentual que paga?1) ______% por **mes**, o 2)_______% por **año**. **(Llenar sólo una)**

32. Durante la temporada de lluvias puedo acceder al________% **(0 - 100%)** de mi finca (**Escribir un porcentaje**)

33. En general, ¿Cómo describiría el clima de negocios, **de 1 a 5,** para los agricultores de su región en los años que se indican? Para el año 2012 por favor indique **sus expectativas**.
    1 = muy mala, 2 = mala, 3 = normal, 4 = buena, 5 =muy buena.
    (Por favor, rellene en los cuadros con la respuesta del 1 al 5)

| 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|
| | | | |

34. Si usted pertenece a un ejido, ¿Es miembro activo en el proceso de toma de decisiones?
    Sí__, No__

35. Por favor escriba los **cinco cultivos principales, ganado o renta que percibe de sus tierras, en los cuadros a la derecha de cada número (1-5),** que haya producido en los años 2009, 2010, 2011 y su plan para el próximo año, 2012, por cantidad de tierra utilizada para cada cultivo o cría, sus rendimientos (ton / ha) y su precio de venta (pesos / ton) **Si no conoce exactamente los valores, indique un aproximado.**

**Por ejemplo, si sembró maíz, crio ganado y rentó tierra, entonces puede poner: 1) Maíz 30Ha 2ton/ha $5,500/ton; 2) ganado 20Ha 10vacas $4,000; 3) Renta 50Ha $1,500/ Ha**

| Año | Orden de importancia | **Cultivo / ganadería / renta** | **Superficie total (Ha)** | **Rendimientos (ton / ha) / número de cabezas de ganado** | **Precio (pesos / ton) o (pesos / cabeza** |
|---|---|---|---|---|---|
| 2009 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

| Año | Orden de importancia | **Cultivo / ganadería / renta** | **Superficie total (Ha)** | **Rendimientos (ton / ha) / número de cabezas de ganado** | **Precio (pesos / ton) o (pesos / cabeza** |
|---|---|---|---|---|---|
| 2010 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

| Año | Orden de importancia | **Cultivo / ganadería / renta** | **Superficie total (Ha)** | **Rendimientos (ton / ha) / número de cabezas de ganado** | **Precio (pesos / ton) o (pesos / cabeza)** |
|---|---|---|---|---|---|
| 2011 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

**Plan para el próximo año:**

| Año | Orden de importancia | **Cultivo / ganadería / renta** | **Superficie total (Ha)** | **Rendimientos (ton / ha) / número de cabezas de ganado** | **Precio (pesos / ton) o (pesos / cabeza)** |
|---|---|---|---|---|---|
| 2012 | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |

36. Aproximadamente, ¿cuánto fue el **total de ingresos (ventas)** de sus **actividades agrícolas o de sus tierras** en los últimos 12 meses? $______________________
A) Aproximadamente cual fue su costo total de producción agrícola en los últimos 12 meses? $________

37. Aproximadamente, ¿qué porcentaje de sus **ingresos totales** proviene de sus actividades agrícolas? _____%
38. ¿Recibe usted apoyos de Procampo? Sí_____, No_____
    A)**En caso afirmativo,** ¿cuánto recibió de Procampo el año pasado? $______
    B)¿Usted: **1)** Produce en su tierra con Procampo, **2)** renta su tierra con Procampo, o **3)** presta ,sin recibir pago, su tierra con Procampo a otros agricultores para que ellos la trabajen? ________
    (Escriba todas las que correspondan: 1, 2 o 3).

39. ¿Recibe usted algún otro subsidio en efectivo, además de Procampo? Si____, No_____

A). ¿Usted o algún miembro de su familia reciben Progresa? Si___, No___
B). **En caso afirmativo,** ¿Cuánto recibió de Progresa el año pasado? $__________
C). ¿Cuánto recibió de otros apoyos en efectivo el año pasado? $_______

40. ¿Cuál fue su **ingreso total** en el último año de **todas sus fuentes de ingresos**, incluidos los ingresos de trabajo formal e informal, empleo, agricultura, programas de gobierno, ganadería y remesas (por favor de su mejor estimación)? (no incluye gastos) $_____________________

41. ¿Cuál fue el **ingreso total neto, (descontando de su ingreso total todos sus gastos de producción agrícola),** en el último año a partir de cualquier fuente, incluidos la agricultura, trabajo formal e informal, la ganadería, y las remesas (por favor de su mejor estimación)?
    (Esto es igual a los ingresos (**P40**) **menos todos los gastos de producción** (salarios, insumos, preparación de tierra) $________________

42. ¿Cuánto gasta en promedio por **mes** en su casa? (Esto incluye comida, escuela, electricidad, gas, salarios, diversión) $________
43. ¿Cuánto ahorra en promedio por **año?** $______

44. Por favor de aproximadamente el porcentaje de sus ingresos agrícolas totales que provienen de ganado ____________%
    (Estime este número si no sabe exactamente)

## *B. Fuentes y Percepciones de riesgo*

45. Por favor, **indique del 1 al 5** si está dispuesto o no a asumir riesgos **(Marque** la respuesta más apropiada). **1**= Total desacuerdo (NO), **2**= Poco de acuerdo, **3**= Mas o menos de acuerdo, **4**= De acuerdo, **5**= Totalmente de acuerdo (SI). Seleccione un número por cada declaración.

| **Declaración** | NO | | Tal Vez | | SI |
|---|---|---|---|---|---|
| A) Estoy dispuesto a aceptar mayores riesgos de producción para aumentar la posibilidad de mayores ganancias | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| B) Estoy dispuesto a correr riesgos con nuevas tecnologías antes de ver buenos resultados en otras fincas | 1 | 2 | 3 | 4 | 5 |
| C) Estoy dispuesto a correr riesgos con nuevas prácticas de manejo antes de ver buenos resultados en otras fincas | 1 | 2 | 3 | 4 | 5 |

(Tecnologías se refieren a nuevas semillas, fertilizantes, etc., las prácticas de manejo se refiere a la rotación de cultivos, uso de contratos, uso de seguros agrícolas)

46. Si usted cultiva maíz, sorgo o soya por favor indique el **precio más bajo que cree** sea posible, el precio que **usted crea que tenga más probabilidades de ser**, y el **precio más alto** que usted crea posible para la **temporada siguiente para todos los cultivos (2011/ 2012)**

    *(Para cada cultivo, las respuestas del más bajo, lo más probable y la más alta, queremos sólo su juicio personal acerca de lo que los precios podrían ser. El precio más probable es el precio esperan recibir en la próxima cosecha. Nota: Lo más probable puede ser la misma que lo más bajo o más alto)*

    (Por favor, rellene las casillas)

| **Cultivo** | **1) Precio más bajo posible** **(pesos / ton)** | **2) Precio más probable** **(pesos / ton)** | **3) Precio más alto posible** **(pesos / ton)** |
|---|---|---|---|
| A) Maíz | | | |
| B) Sorgo | | | |
| C) Soya | | | |

47. Si usted cultiva maíz, sorgo o soya, por favor indique **el rendimiento más bajo** que considere sea posible, el rendimiento que usted considere sea **el más probable** que reciba, y el rendimiento **más alto** que considere **posible** para la **temporada siguiente para todos los cultivos (2011/ 2012).**

    *Nota: Lo más probable puede ser la misma como lo más bajo o más alto)*
    (Por favor, rellene las casillas)

| **Cultivo** | **1) Rendimiento más bajo posible** **(ton / ha)** | **2) Rendimiento más probable** **(ton / ha)** | **3) Rendimiento más alto posible** **(ton / ha)** |
|---|---|---|---|
| A) Maíz | | | |
| B) Sorgo | | | |
| C) Soya | | | |

48. Si usted cultiva maíz, sorgo o soya cuál ha sido el menor y mayor rendimiento de estos cultivos (ton / ha) que usted recuerde en todos sus años en la agricultura?

    (Por favor, rellene las casillas)

| **Cultivo** | **1) Menor rendimiento** | **2) Año en que se** | **3) Mayor rendimiento** | **4) Año en que se produjo** | **5) Rendimiento promedio** |
|---|---|---|---|---|---|

| | histórico (Ton / ha) | produjo | histórico (Ton / ha) | | histórico. (rendimiento normal) (Ton / ha) |
|---|---|---|---|---|---|
| A) Maíz | | | | | |
| B) Sorgo | | | | | |
| C) Soya | | | | | |

## *C. Opciones y Percepciones para Manejo de Riesgos*

49. Por favor, indique la **importancia que usted cree** que cada artículo tenga en términos de manejo de riesgos en su finca. También marque en el espacio **si usted utiliza** la opción para manejo de riesgo en su operación. Seleccione:
    **1** = Nada importante, **2** = Poco importante, **3** = Neutral, **4** = Importante, **5** = Muy importante **(**Marque la respuesta más apropiada). seleccione en el cuadro en blanco si utiliza la opción.

Circule del 1 al 5, incluso si usted no utiliza la opción de manejo de riesgo.

| ***Opciones de gestión de riesgos*** | **Marque si lo utiliza** | **Nada importante Importante** | | | | **Muy** |
|---|---|---|---|---|---|---|
| A) Sembrar más de un cultivo, cría de animales, o la diversificación agrícola | | 1 | 2 | 3 | 4 | 5 |
| B) Tierra o fincas en diferentes ubicaciones (diversificación geográfica) | | 1 | 2 | 3 | 4 | 5 |
| C) Riego | | 1 | 2 | 3 | 4 | 5 |
| D) Difusión de las ventas: Vender cada producto a lo largo del año en lugar de todo a la misma vez | | 1 | 2 | 3 | 4 | 5 |
| E) El uso de contratos para comercializar su cosecha por adelantado a un precio fijo | | 1 | 2 | 3 | 4 | 5 |
| F) Los programas de gobierno | | 1 | 2 | 3 | 4 | 5 |
| G) El mantenimiento de las reservas financieras: tener dinero en efectivo y activos líquidos (por ejemplo, maquinarias, ganado) | | 1 | 2 | 3 | 4 | 5 |
| H) La inversión no agrícola para tener otras fuentes de ingresos | | 1 | 2 | 3 | 4 | 5 |
| I) Trabajo formal fuera de la finca, empleado. | | 1 | 2 | 3 | 4 | 5 |

~~50.~~

~~51.~~

52. Cuando elijo qué cultivos sembrar, tomo mi decisión en base a:
    **(Por favor circule el número apropiado de 1 - 5).**

| Factores | No es un factor | | | | Factor muy importante |
|---|---|---|---|---|---|
| A)El precio actual de la cosecha | 1 | 2 | 3 | 4 | 5 |
| B) La variación en el precio | 1 | 2 | 3 | 4 | 5 |
| C)El rendimiento medio por hectárea | 1 | 2 | 3 | 4 | 5 |
| D)La variación en el rendimiento por hectárea | 1 | 2 | 3 | 4 | 5 |
| E)El costo promedio por hectárea | 1 | 2 | 3 | 4 | 5 |
| F)La variación en el costo por hectárea | 1 | 2 | 3 | 4 | 5 |
| G)El grado de violencia en la zona | 1 | 2 | 3 | 4 | 5 |

## *D. Uso de Seguros para Cultivos y Percepciones*

*El seguro de cosecha es una herramienta común utilizada por los agricultores estadounidenses. El seguro de cosecha se paga si el* ***rendimiento*** *de la cosecha cae por debajo de un cierto porcentaje de su* ***rendimiento promedio.*** *Por ejemplo, si su rendimiento promedio es de 2 ton / ha para un cultivo en particular, el seguro puede proporcionar un pago si el rendimiento del cultivo actual cae por debajo de este promedio. Por ejemplo, si el rendimiento real es 1ton/ha entonces usted recibirá un pago basado en la diferencia entre las dos toneladas y 1ton (= 1 tonelada), por el precio promedio de la cosecha. Si el precio es de $ 2,000 / ton entonces usted recibirá $ 2,000 * (2-1) = $ 2,000, pero si los rendimientos son superiores a 2 toneladas / ha no recibe nada de la aseguradora.*

53. ¿Hay seguros de cultivos actualmente disponibles para usted?
Sí_____, No_____ (Si no, pase a ***P 56***)

54. ***(Conteste si la respuesta a P 53 es afirmativa)*** ¿Usted compra seguros de cosecha?
Sí_____, No_____ (Si no, pase a ***P 57***)

55. ***(Conteste si la respuesta es Sí a P 53)*** Liste los cultivos para los cuales compra seguros de cosecha. ¿Cuánto paga de prima de seguro por hectárea?

| **Cultivos** | **Prima del seguro (pesos / Ha)** |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

56. ***(Si la respuesta a P 53 es No)*** En caso de que le ofrezcan seguros de cosecha, ¿Cree usted que los compraría? Sí_____, No_____

57. Si usted cultiva maíz, sorgo o soya, ¿cuál cultivo cree usted que tenga una mayor probabilidad de una pérdida significativa de rendimiento en el próximo año?
**Maíz ________, Sorgo _______, Soya _______**

**(Sólo puede seleccionar uno.** Seleccione el cultivo que siembra si sólo siembra uno)

Por favor, seleccione **P 58, P 59 o P 60** basado en el cultivo que eligió en el **P 57.**

58. (Conteste si selecciono **MAIZ en P 57**) Imagine un producto de seguro de cosechas que garanticen que sus **ingresos de ventas por hectárea nunca serán inferiores a $ 9,800 / ha para el maíz.** Teniendo en cuenta todos los rendimientos de las cosechas anteriores, y lo que usted cree sobre el rendimiento del cultivo para el próximo año. Producto puesto en reciba.

A)¿Estaría usted dispuesto a pagar **$1,470 / ha** para garantizar un mínimo de venta de **$9,800 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

B)¿Estaría usted dispuesto a pagar **$785/ ha** para garantizar un mínimo de venta de **$9,800 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

C)¿Estaría usted dispuesto a pagar **$295 / ha** para garantizar un mínimo de venta de **$9,800 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

D)¿Estaría usted dispuesto a pagar **$50/ ha** para garantizar un mínimo de venta de **$9,800 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

59. (Conteste si selecciono **SORGO en P 57**) Imagine un producto de seguro de cosechas que garanticen que sus **ingresos de ventas por hectárea nunca serán inferiores a $ 6,500 / ha para el sorgo.** Teniendo en cuenta todos los rendimientos de las cosechas anteriores, y lo que usted cree sobre el rendimiento del cultivo para el próximo año. Producto puesto en reciba.

A). ¿Estaría usted dispuesto a pagar **$975 / ha** para garantizar un mínimo de venta de **$6,500 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

B)¿Estaría usted dispuesto a pagar **$520/ ha** para garantizar un mínimo de venta de **$6,500 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

C).¿Estaría usted dispuesto a pagar **$195/ ha** para garantizar un mínimo de venta de **$6,500 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

D)¿Estaría usted dispuesto a pagar **$32 / ha** para garantizar un mínimo de venta de **$6,500 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

60. (Conteste si selecciono **SOYA en P 57**) Imagine un producto de seguro de cosechas que garanticen que sus **ingresos de ventas por hectárea nunca serán inferiores a $ 8,600 / ha para la soya.** Teniendo en cuenta todos los rendimientos de las cosechas anteriores, y lo que usted cree sobre el rendimiento del cultivo para el próximo año. Producto puesto en reciba.

A).¿Estaría usted dispuesto a pagar **$1,290 / ha** para garantizar un mínimo de venta de **$8,600 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

B).¿Estaría usted dispuesto a pagar **$670/ ha** para garantizar un mínimo de venta de **$8,600 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

C).¿Estaría usted dispuesto a pagar **$260 / ha** para garantizar un mínimo de venta de **$8,600 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

D).¿Estaría usted dispuesto a pagar **$43 / ha** para garantizar un mínimo de venta de **$8,600 / ha.?**
1) Definitivamente lo compro (Si)__, 2) Probablemente lo compro ___,
3) Probablemente no lo compro_____, 4) Definitivamente no lo compro (No)_____

Continúe con la P61

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61. Teniendo en cuenta todos los aspectos del hogar, incluyendo su finca, consultas medicas y operaciones, su casa y contenidos, automóviles, maquinaria y equipo ¿Suele comprar un seguro para cualquiera de los siguientes elementos? ***(Dejar en blanco si no aplica):***

    a. Seguro de Vida: Sí_____ No____
    b. Seguro contra incendios para el hogar y su contenido: Sí_____ No____
    c. Seguro de Automóviles: Sí_____ No____
    d. Seguro médico (no seguro social): Sí_____ No____
    e. Protección contra la pérdida de cultivos (seguro de cosechas): Sí_____ No____
    f. Protección contra la pérdida de ganado (seguro ganadero): Sí_____ No____
    g. Otros ____________________________________________

62. Si existiera un tipo de préstamo que le proteja contra el exceso de lluvia o duración de la sequía, de tal manera que su **deuda disminuyese** al aumentar la duración de la sequía o la intensidad de las lluvias. ¿Estaría usted interesado en un préstamo con este tipo de seguro aunque tuviera que pagar **una mayor tasa de interés**?

1). No, en absoluto ____, 2). Moderadamente interesado_____, 3). Muy Interesado_____

~~63.~~

## *E. Finanzas y Gestión de Riesgos*

64. ¿Tiene usted alguna deuda pendiente? Si____, No _____
A)**.EN CASO AFIRMATIVO,** indique la cantidad total de dinero que debe $___________

B). Por favor, indique la cantidad total de dinero que usted debe y la tasa de interés que le cobran de:

| | 1 | 2 |
|---|---|---|
| | Monto del préstamo<br>$ | Tasa de interés **anual**<br>% |

| | | |
|---|---|---|
| A) Amigos | | |
| B) Familiares | | |
| C) Instituciones financieras | | |
| D) Prestamistas / Casa de empeño | | |
| E) Préstamos del gobierno | | |
| F) Compradores | | |
| G) Proveedores de Insumos | | |
| H) Asociación de productores | | |
| I) Otros | | |

65. Si usted vendiera todos sus bienes (casa, tierras, ganado, productos agrícolas, etc.) ¿Cuánto estima usted que pueda recibir? $______________

66. En cuanto al monto total actual de sus deudas, activos y productividad, ¿qué piensa usted acerca de su nivel de endeudamiento? (Marque solamente uno)

A). 1). Muy bajo___, 2) Bajo___, 3) Adecuado___, 4) Alto___, 5) Muy alto___

B). ¿Alguna vez le han negado un préstamo el Comprador, Banco, Gobierno o cualquier institución financiera? Si____, No____

C). **En caso afirmativo,** ¿cuáles son las razones principales por las que se le negó el crédito? (Responda a más de uno si es necesario)

1). Garantías insuficientes ___________
2). Mi principal fuente de ingresos tiene demasiado riesgo en el precio ______
3). No he podido pagar un préstamo en el pasado __________
4). El banco no cree que yo pueda pagar ___________
5). Las fechas de pagos requeridos por el banco / prestamista no coincide con las fechas de venta de mis productos ________

67. ¿Ha podido obtener un **crédito** de compradores, bancos o prestamistas**, para todo lo que necesita**? (Marque sólo uno) : 1). Nunca ____, 2). A veces ___, 3) Siempre_____

A). **Conteste si selecciono 2) A veces,** ¿Qué porcentaje aproximado de los préstamos que ha pedido se le otorgaron en la cantidad total que usted solicitó? ______%

68. ¿Alguna vez se **ha atrasado** en el pago de un préstamo de las siguientes fuentes? (Por "atrasar" nos referimos a que el pago no fue pagado puntualmente según lo acordado por el prestamista, pero el pago se hizo después.)

a. Parientes: Sí_____, No______
b. Amigos: Sí_____, No______
c. Prestamistas: Sí_____, No______

d. Gobierno: Sí_____, No______
e. Compradores: Sí_____, No______
f. Proveedores de Insumos: Sí_____, No______
g. Banco Comercial: Sí_____, No______
h. Asociación de Productores: Si_____, No_____
i. Otros Sí_____, No______

69. ¿Alguna vez ha **dejado de pagar** un préstamo de las siguientes fuentes? (ENTREVISTADOR: Por incumplimiento se entiende que el préstamo **nunca** fue **reembolsado** según lo acordado por el prestamista)

a. Parientes: Sí_____, No______
b. Amigos: Sí ____, No______
c. Prestamistas: Sí_____, No______
d. Gobierno: Sí_____, No______
e. Compradores: Sí_____, No______
f. Proveedores de Insumos: Sí_____, No______
g. Banco Comercial: Sí_____, No______
h. Asociación de Productores: Sí_____, No______
i. Otros: Sí_____, No______

70. En su región, ¿Cuál de estas dos afirmaciones es la correcta?

A) Los compradores o los bancos evalúan mi solvencia y **me ofrecen un préstamo** o tarjeta de crédito sin que yo lo solicite. VERDADERO______, FALSO________

B) Debo **solicitar formalmente un préstamo** de mi comprador o banco: VERDADERO_______, FALSO_______

(***P 70*** A y B son mutuamente excluyentes: si uno es falso el otro es verdadero)

SI ***P 70 B*** **es verdadero** pase a la ***P 77***, de lo contrario continúe en la P71.

71. ***(Conteste si la respuesta a la P 70 A es*** VERDADERO***)*** Sobre la OFERTA más reciente de préstamo o de tarjeta de crédito, aproximadamente ¿cuánto le ofreció el comprador o el banco prestarle? $__________ (límite de la tarjeta de crédito u oferta de préstamo)

72. De la cantidad ofrecida en ***P 71*,** ¿Qué cantidad del préstamo (en Pesos) utilizó? (No deje en blanco. Ponga 0 si no se utilizó, si no sabe ponga 9999) $_______________

73. ***(Conteste si la respuesta a P 72 es mayor a cero)*** ¿En que se utilizó el préstamo mencionado en la ***P 72*** (marque más de una respuesta si es necesario)?

a. Producción agrícola: Sí_____, No____
b. Construcción / renovación de la casa: Sí_____, No____
c. Compra de coche / moto / bicicleta: Sí_____, No____
d. Gasto diario de la casa: Sí_____, No____
e. Gastos médicos: Sí_____, No____
f. Gastos de educación: Sí_____, No____
g. Otros: Sí_____, No____

74. ¿Es la cantidad del préstamo que utilizó en ***P 72*** menor, igual o mayor a la cantidad que **realmente necesitó** para el propósito indicado en la ***P 73?*** (ENTREVISTADOR: recordar al entrevistado la respuesta a ***P 72)***

A) Menor _____, B) Igual ______, C) Mayor _______

75. ***(Conteste si la respuesta a P 72 es menor a P 71)*** Si la cantidad utilizada fue **menor** que la cantidad que el prestamista le ofreció, ¿Cuales cree usted que son las principales razones de que ***no haya utilizado*** el importe total del crédito ofrecido? (responda más de uno si es necesario)

   a. Yo no necesito de préstamos / No invierto: Sí_____, No____
   b. Tengo dinero y ahorros para invertir: Sí_____, No____
   c. Me prestaron mis amigos: Sí_____, No____
   d. La tasa de interés es muy alta: Sí_____, No____
   e. Tengo miedo de perder la garantía: Sí_____, No____
   f. No creen que pueda pagar el préstamo: Sí_____, No____
   g. No puedo obtener una garantía: Sí_____, No____
   h. Los prestamos no son lo suficientemente flexibles para cumplir con mi capacidad de pago: Sí_____, No____
   i. Otros: Sí_____, No____

76. ¿Cree usted que tiene una **garantía suficiente** para asegurar un monto de préstamo más alto que el identifico en la **P *71?*** Sí________, No______

PASE A LA P 89

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77. ***(Conteste si la respuesta a P 70 B es* verdadero*)*** ¿Ha solicitado un préstamo de su banco o comprador en los últimos 2 años? Sí____, No_______ **(Si la respuesta es Sí, continúe con la P 78; Si no, pase a *P 86)***

78. ***(Conteste si respuesta a P 77 es Sí)*** En la **solicitud de préstamo más reciente** ¿Cuál es la cantidad que solicitó aproximadamente? $__________

79. ¿Cuánto dinero le ofreció el comprador o el banco? $____________
(escriba 0 si el préstamo fue negado)

80. ***(Conteste si la respuesta a P 79 es mayor a cero)*** ¿Aceptó el préstamo ofrecido?
Sí______, No_______ **(Si la respuesta es Sí, continúe con la P 81; Si no, pase a *P 83)***

81. ***(Conteste si la respuesta a P 80 es Sí)*** ¿Para qué fines utilizó el préstamo ofrecido? (responda a más de uno si es necesario)

   a. Producción agrícola: Sí_____, No____
   b. Construcción / renovación de la casa: Sí_____, No____
   c. Compra de coche / moto / bicicleta: Sí_____, No____
   d. Gasto diario de la casa: Sí_____, No____
   e. Gastos médicos: Sí_____, No____
   f. Gastos de educación: Sí_____, No____
   g. Otros: Sí_____, No____

82. ¿Es la cantidad del préstamo que recibió en la ***P 79*** menor, igual o mayor que la cantidad que **realmente necesitó** para lo indicado en la ***P 81***? (ENTREVISTADOR: recordar al entrevistado su respuesta a ***P 79)***

A) Menor _____, B) Igual ______, C) Mayor _______

83. ***(Conteste si la respuesta a la P 80 es No)*** ¿Por qué no aceptó el préstamo ofrecido? (responda a más de uno si es necesario)

a. El importe del préstamo ofrecido es muy poco para lo que planeaba invertir: Sí_____, No____
b. Me prestaron mis amigos: Sí_____, No____
c. La tasa de interés es muy alta: Sí_____, No____
d. Tengo miedo de perder la garantía: Sí_____, No____
e. Los prestamos no son lo suficientemente flexibles para cumplir con mi capacidad de pago: Sí_____, No____
f. Otros: Sí_____, No____

84. ¿Cree usted que tiene una garantía suficiente para asegurar un préstamo más alto del que mencionó en la ***P 79*?** Sí______, No______

85. ***(Conteste si su respuesta a la P 78 es menor a la P 79)*** ¿Cuáles cree usted que sean las principales razones por las que se le negó total o parcialmente su solicitud de crédito? (conteste más de una respuesta si es necesario)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Razones | Altamente probable | Muy probable | Probable | Poco probable | No es probable |
| a. Garantía insuficiente | | | | | |
| b. Demasiado riesgo en el precio | | | | | |
| c. Demasiado riesgo en la producción | | | | | |
| d. El cultivo es demasiado vulnerable al clima | | | | | |
| e. Yo no he podido pagar un préstamo en el pasado | | | | | |
| f. El banco cree que yo no puedo pagar el préstamo | | | | | |
| g. El banco cree que no tengo un ingreso suficiente | | | | | |
| h. Las fechas de pago requerido por el banco no coincide con las fechas de venta de mis productos. | | | | | |
| i. No tuve aval para el préstamo. | | | | | |

| j. Otros | | | | | |
|---|---|---|---|---|---|

PASE A LA P89

86. ***(Conteste si la respuesta a P 77 es No)*** ¿Por qué no ha solicitado un préstamo de su comprador o banco en los últimos 2 años? (conteste más de una respuesta si es necesario)

a. Yo no necesito de préstamos / No invierto: Sí_____, No____
b. Tengo dinero y ahorro para invertir: Sí_____, No____
c. Me prestaron mis amigos: Sí_____, No____
d. La tasa de interés es muy alta: Sí_____, No____
e. Tengo miedo de perder la garantía: Sí_____, No____
f. No creen que pueda pagar el préstamo: Sí_____, No____
g. No puedo obtener una garantía: Sí_____, No____
h. Los prestamos no son lo suficientemente flexibles para cumplir con mi capacidad de pago: Sí_____, No____
i. Otros: Sí_____, No____

87. ¿Cree usted que usted tiene una **garantía suficiente** para obtener un crédito agrícola adecuado?
A) Sí ________, B) No ________, C) No estoy seguro ________

88. **(Conteste si la respuesta a P 87 es No, o No está seguro)**, Suponiendo que tenga las garantías suficientes para obtener cualquier préstamo que necesite. ¿Pediría prestado una cantidad mayor?
A) Sí ________, B) No ________, C) No estoy seguro ________

CONTINUE EN LA P 89

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89. Cuando usted toma una decisión sobre si **pedir un préstamo y cuánto** pedir prestado, ¿Qué tan importantes son las **siguientes declaraciones?**: (Seleccione una opción de cada declaración). Al Pedir un Préstamo considera que,

| Declaración | Nada Importante | Poco Importante | Importante | Muy Importante | Demasiado Importante |
|---|---|---|---|---|---|
| A) El riesgo de perder mi negocio es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| B) El riesgo de no enviar a mis hijos a la escuela es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| C El riesgo de a no tener suficiente dinero para comprar comida es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| D) El riesgo de no tener suficiente dinero para gastos médicos es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| E) El riesgo de no tener un lugar para vivir es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| F) El riesgo de no tener suficiente dinero cuando me jubile es | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| importante para mí. | | | | | |
| G) El riesgo de perder oportunidades para pedir préstamos en el futuro es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| H) El riesgo de perder mi reputación social dentro de mi comunidad es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| I) El riesgo de no tener suficientes ahorros para cubrir pérdidas es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| J) El riesgo de no poder vivir de forma segura ahora que estoy grande es importante para mí. | 1 | 2 | 3 | 4 | 5 |
| K) El riesgo de no poder trabajar fuera de la agricultura debido a que no tengo conocimientos es importante para mí. | 1 | 2 | 3 | 4 | 5 |

90. ***(*Conteste si su respuesta a P75 (g) o Q86 (g) es Sí)** ¿Si usted pudiera obtener una garantía, solicitaría un préstamo? Sí_____, No _____

91. ¿Ha recibido tarjetas de crédito no solicitadas, o le han ofrecido una línea de crédito sin solicitarla de cualquier fuente, incluye asociación de productores y compradores?
Sí_____, No _____

92. ¿Cuánto debe actualmente en préstamos de compradores o bancos? $ __________

93. Supongamos que usted puede pedir prestado **tanto como usted necesite** para cubrir **todas sus necesidades de crédito**. ¿Solicitaría crédito bajo las siguientes tasas de interés anuales? (Por favor **circule para cada tasa de interés una de las cinco opciones del 1 al 5**)

| Tasa de interés **mensual** % | Tasa de interés **anual** % | Definitivamente pediría prestado para todo lo que necesite (Si) | Posiblemente pediría prestado | Tal vez pediría prestado | Tal vez pediría prestado un poco | Definitivamente no pediría prestado (No) |
|---|---|---|---|---|---|---|
| 0.42% | 5 % | 1 | 2 | 3 | 4 | 5 |
| 1.25% | 15 % | 1 | 2 | 3 | 4 | 5 |
| 2.08% | 25 % | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **2.92%** | **35%** | 1 | 2 | 3 | 4 | 5 |
| 3.75% | 45 % | 1 | 2 | 3 | 4 | 5 |
| 4.58% | 55 % | 1 | 2 | 3 | 4 | 5 |
| 5.83% | 70 % | 1 | 2 | 3 | 4 | 5 |
| 7.50% | 90 % | 1 | 2 | 3 | 4 | 5 |

94. Si ***pudiera pedir más dinero prestado*** de lo que puedo pedir ahora con la ***misma tasa de interés,*** sería probable que pidiera más prestado.

1) Totalmente de acuerdo (Si)____, 2) De acuerdo_____, 3) Mas o menos de acuerdo_____,
4) Poco de acuerdo ____, 5) Totalmente en desacuerdo (No)____

95. Estaría dispuesto a ***pagar mayores intereses*** para poder ***obtener un préstamo más grande del que actualmente le ofrecen.***

1) Totalmente de acuerdo (Si)____, 2) De acuerdo_____, 3) Mas o menos de acuerdo_____,
4) Poco de acuerdo ____, 5) Totalmente en desacuerdo (No)____

96. Si ***las tasas de interés fueran más bajas que las actuales,*** Seria muy probable que pidiera prestado más**.**

1) Totalmente de acuerdo (Si)____, 2) De acuerdo_____, 3) Mas o menos de acuerdo_____,
4) Poco de acuerdo ____, 5) Totalmente en desacuerdo (No)____

97. Si ***el costo*** de obtener un préstamo (cuotas, cargos por solicitud, **no incluye intereses**) de los compradores o bancos **fueran inferiores** a los costos actuales, sería muy probable que yo les pidiera prestado a ellos.

1) Totalmente de acuerdo (Si)____, 2) De acuerdo_____, 3) Mas o menos de acuerdo_____,
4) Poco de acuerdo ____, 5) Totalmente en desacuerdo (No)____

98. ¿Alguna vez se **ha atrasado en el pago** de un préstamo de las siguientes fuentes? (Por "atrasado" nos referimos a que el pago no fue pagado puntualmente según lo acordado por el prestamista, **pero el pago se hizo después)**

| | 1 | 0 |
|---|---|---|
| | Sí | No |
| a. Amigos | | |
| b.Familiares | | |
| c.Bancos/ Instituciones financieras | | |
| d.Proveedores de insumos / Compradores | | |
| e. Casa de empeño | | |
| g.Otros | | |

99. ¿Alguna vez **ha incumplido** en el pago de algún préstamo? (Por incumplimiento se entiende que el **préstamo nunca fue reembolsado en su totalidad** según lo acordado por el prestamista)

| | Sí (1) | No (0) |
|---|---|---|
| a. Amigos | | |
| b. Familiares | | |
| c. Bancos/ Instituciones financieras. | | |
| d. Proveedores/ compradores de grano | | |
| e. Casa de empeño | | |
| g. Otros | | |

**Las siguientes preguntas son sobre su ahorro.**

100. ¿Qué proporción de los ingresos totales en su hogar ahorra en un año?
1) Nada___, 2) Menos del 5%___, 3) Entre el 5 y el 10%___, 4) Más del 10%___

101. ¿Cuáles son las razones principales de sus ahorros? (Seleccione un numero por cada declaración)

| Declaración | Total Desacuerdo (NO) | Poco de Acuerdo | Más o menos de acuerdo (Tal Vez) | De Acuerdo | Totalmente de Acuerdo (SI) |
|---|---|---|---|---|---|
| A) Guardo porque no tengo nada en que gastar dinero. | 1 | 2 | 3 | 4 | 5 |
| B) Ahorro para comprar una casa | 1 | 2 | 3 | 4 | 5 |
| C) Ahorro para la comprar un automóvil | 1 | 2 | 3 | 4 | 5 |
| D) Ahorro para cuando se descomponga mi automóvil | 1 | 2 | 3 | 4 | 5 |
| E) Ahorro para viajar o divertirme | 1 | 2 | 3 | 4 | 5 |
| F) Ahorro para poder invertir fuera de la agricultura y ganadería en el futuro | 1 | 2 | 3 | 4 | 5 |
| G) Ahorro para poder pagar mi préstamo | 1 | 2 | 3 | 4 | 5 |
| H) Ahorro para emergencias medicas | 1 | 2 | 3 | 4 | 5 |
| I) Ahorro para poder enviar a mis hijos a la escuela | 1 | 2 | 3 | 4 | 5 |
| J) Ahorro para la boda de mis hijos | 1 | 2 | 3 | 4 | 5 |
| K) Ahorro para poder cuidar a mis padres | 1 | 2 | 3 | 4 | 5 |
| L) Ahorro para protegerme si pierdo mi trabajo | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| M) Ahorro para las cubrir las perdidas agrícolas | 1 | 2 | 3 | 4 | 5 |
| N) Ahorro para tener dinero de protección o rescate | 1 | 2 | 3 | 4 | 5 |
| O) Ahorro por otros motivos | 1 | 2 | 3 | 4 | 5 |

102. En su opinión, ¿cree que el ahorro es importante?

1) Total desacuerdo (No)____,   2) Poco de acuerdo___,   3) Más o menos de acuerdo_____,
4) De Acuerdo___, 5) Totalmente de acuerdo (Si)_____

103. Por favor seleccione el grado de acuerdo de cada una de las siguientes declaraciones.

| Declaración | Total Desacuerdo (NO) | Poco de Acuerdo | Mas o menos de acuerdo (Tal Vez) | De Acuerdo | Totalmente de Acuerdo (SI) |
|---|---|---|---|---|---|
| A) No tengo miedo de pedir prestado a bancos o compradores | 1 | 2 | 3 | 4 | 5 |
| B) Tengo deudas pendientes de con bancos o compradores | 1 | 2 | 3 | 4 | 5 |
| C) Las tasas de interés de los bancos o compradores **son más altas** que las tasas de interés de los préstamos de amigos o familiares | 1 | 2 | 3 | 4 | 5 |
| D) Las tasas de interés de los bancos o compradores son más altas de lo que puedo pagar | 1 | 2 | 3 | 4 | 5 |
| E) Yo **preferiría** pedir prestado a un amigo o familiar | 1 | 2 | 3 | 4 | 5 |
| F) No me gusta estar en deuda con bancos o compradores | 1 | 2 | 3 | 4 | 5 |

## *F. Impacto en Racionamiento de Crédito*

Restricción crediticia significa que el productor no puede obtener **todos** los fondos solicitados a un banco o comprador en las cantidades o en el tiempo requerido.

104. Por favor seleccione el grado de acuerdo de cada una de las siguientes declaraciones

| Declaración | Total | Poco de | Más o | De | Totalmen |
|---|---|---|---|---|---|

| | Desacuerdo (NO) | Acuerdo | menos de acuerdo (Tal Vez) | Acuerdo | te de Acuerdo (SI) |
|---|---|---|---|---|---|
| A) Si no me prestan el dinero que solicito, usaría menos insumos de los requeridos | 1 | 2 | 3 | 4 | 5 |
| B) Si no me prestan el dinero que solicito, necesitare buscar empleo para conseguir dinero | 1 | 2 | 3 | 4 | 5 |
| C) Si no me prestan el dinero que solicito, no podría dar educación y atención médica para mi familia | 1 | 2 | 3 | 4 | 5 |
| D) Si no me prestan el dinero que solicito, mi familia y yo no seríamos capaces de obtener una buena alimentación todo el año | 1 | 2 | 3 | 4 | 5 |
| E) Yo preferiría pedir prestado a **un banco** a una tasa de interés **muy baja** en vez de pedirle prestado a algún **familiar o pariente** | 1 | 2 | 3 | 4 | 5 |
| F) Yo preferiría pedir prestado a **un banco** a la tasa de interés actual, en vez de pedirle prestado a algún **familiar o pariente** | 1 | 2 | 3 | 4 | 5 |
| G) Yo preferiría pedir prestado a **un banco** a una tasa de interés muy baja en vez de pedirle prestado a algún **amigo** | 1 | 2 | 3 | 4 | 5 |
| H) Yo preferiría pedir prestado a **un banco** a la tasa de interés actual en vez de pedirle prestado a algún **amigo** | 1 | 2 | 3 | 4 | 5 |

105. Si pudiera conseguir tanto crédito como yo necesitara de un banco o del comprador, ¿Que sería lo más probable que haga? (elija sólo una)

1) Dejar la agricultura e iniciar un negocio no agrícola: _____
2) Dejar la agricultura y trabajar como empleado fuera de la finca: _____
3) Permanecer en la agricultura y aumentar la producción agrícola: ______
4) Permanecer en la agricultura, e iniciar un negocio no agrícola: ____
5) Ninguna de las anteriores _____

105 A) Si le ofrecieran trabajo. Cuál sería el **menor salario** mensual que usted aceptaría para que usted deje de trabajar su tierra, ya sea que la venda o rente, para irse a trabajar de empleado de tiempo completo? $_____________

## *G. Derechos de Uso de Tierra*

106. Tiene usted la posesión legal de sus tierras? esto es, puede vender o hipotecar su tierra libremente? Si___, No___
~~107.~~
~~108.~~
~~109.~~
~~110.~~
~~111.~~
~~112.~~

113. En promedio, ¿cuál es el precio de una hectárea en buenas condiciones en su región? $________
114. Nos gustaría saber acerca de las fuentes de información en su comunidad. Por favor, indique el grado de confiabilidad que usted cree de cada fuente de información.
**Seleccione de cada fuente de información del 1 al 5.**

| | Fuente de Información | Nada Confiable | Poco Confiable | Confiable | Muy Confiable | Totalmente Confiable |
|---|---|---|---|---|---|---|
| A | Periódicos | 1 | 2 | 3 | 4 | 5 |
| B | TV/ Radio | 1 | 2 | 3 | 4 | 5 |
| C | Internet | 1 | 2 | 3 | 4 | 5 |
| D | Familia | 1 | 2 | 3 | 4 | 5 |
| E | Gobierno Local | 1 | 2 | 3 | 4 | 5 |
| F | Universidades, Tecnológicos, Escuelas | 1 | 2 | 3 | 4 | 5 |
| G | Prestamista Local, Comprador | 1 | 2 | 3 | 4 | 5 |

## *H. Percepción y Motivos Riesgo*

115. Imagine que alguien le ofrece jugar un volado. Cada resultado del volado, águila o sol, tiene 50% de probabilidad de salir. Dependiendo de lo que salga usted puede recibir dinero o no. En este juego usted no pierde dinero, solo que los pagos varían Por ejemplo, si sale águila ganara la cantidad de la primera columna, y si sale sol obtendrá la cantidad de la segunda columna, o al revés. Usted solamente escoge el volado con los pagos que prefiera. Si el juego se repitiera por muchas veces se esperaría recibir la cantidad en la tercera columna. Si bien las probabilidades de recibir la cantidad de la primera columna son las mismas que las probabilidades de la segunda columna los valores de cada una, son diferentes.
**Estudie los seis volados en la tabla siguiente** y **seleccione el que usted prefiera**.
**Seleccione el juego del 1 al 6 que prefiera**.________

| **Volado** | Ganancia con buena suerte (50% probabilidad) | Ganancia con mala suerte (50% probabilidad) | Valor esperado |
|---|---|---|---|
| 1 | $500 | $500 | $500 |
| 2 | $950 | $450 | $700 |
| 3 | $1,200 | $400 | $800 |
| 4 | $1,500 | $300 | $900 |
| 5 | $1,900 | $100 | $1000 |

| | | | |
|---|---|---|---|
| 6 | $2,000 | 0 | $1000 |

~~116.~~
~~117.~~
~~118.~~

Las siguientes preguntas son de carácter voluntario. Sería de gran ayuda para entender su situación, preguntándole sobre los acontecimientos importantes que puedan haber ocurrido en su vida recientemente.

119. En su casa, ¿hay algún miembro de su familia (en los últimos 3 años) que se haya divorciado?
Sí_____, No_____

120. En su casa, ¿ha experimentado (en los últimos 3 años) la muerte de algún miembro de la familia? Sí_____, No_____

## *I Percepción de Inseguridad*

121. ¿Está usted consciente de la actual Guerra contra las Drogas en el país?
1) Sí ______, 2) No ______, 3) No estoy seguro ________

122. ¿Qué tan seguro crees que haya sido vivir en tu comunidad / ciudad en los siguientes años? (circule un número del 1 al 5 por cada año)

| Años | Totalmente Inseguro | Muy inseguro | Inseguro | Seguro | Totalmente seguro |
|---|---|---|---|---|---|
| A) **2011** | 1 | 2 | 3 | 4 | 5 |
| B) **2010** | 1 | 2 | 3 | 4 | 5 |
| C) **2009** | 1 | 2 | 3 | 4 | 5 |

123. ¿Qué tan preocupado está usted respecto al crimen en su comunidad / ciudad? (circule el número correspondiente)

| No estoy preocupado | No muy preocupado | Un poco preocupado | Muy preocupado | Demasiado preocupado |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

124. ¿Qué tan preocupado está usted respecto al crimen en los **caminos y carreteras** que utiliza?

| No estoy preocupado | No muy preocupado | Un poco preocupado | Muy preocupado | Demasiado preocupado |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

125. ¿Cuánto cree que el crimen en su **comunidad o ciudad** haya cambiado con **respecto a 2010**?

| El crimen ha disminuido mucho | El crimen ha Disminuido poco | El crimen se ha mantenido igual | El crimen ha aumentado poco | El crimen ha |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | | | | aumentado mucho |
| 1 | 2 | 3 | 4 | 5 |

126. ¿Cómo califica el nivel de violencia en tu **comunidad o ciudad** durante los siguientes años? (Circule un numero por cada año)

| Año | Muy bajo | Bajo | Normal | Alto | Muy Alto |
|---|---|---|---|---|---|
| **2011** | 1 | 2 | 3 | 4 | 5 |
| **2010** | 1 | 2 | 3 | 4 | 5 |
| **2009** | 1 | 2 | 3 | 4 | 5 |
| **2008** | 1 | 2 | 3 | 4 | 5 |

127. ¿Cuánto cree que el crimen en los **caminos y carreteras** que utiliza haya cambiado con **respecto a 2010**?

| El crimen ha disminuido mucho | El crimen ha Disminuido poco | El crimen ha se ha mantenido igual | El crimen ha aumentado poco | El crimen ha aumentado mucho |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

128. ¿Cómo califica el nivel de violencia en los **caminos y carreteras** que utiliza durante los siguientes años? (Circule un numero por cada año)

| Año | Muy bajo | Bajo | Normal | Alto | Muy Alto |
|---|---|---|---|---|---|
| **2011** | 1 | 2 | 3 | 4 | 5 |
| **2010** | 1 | 2 | 3 | 4 | 5 |
| **2009** | 1 | 2 | 3 | 4 | 5 |
| **2008** | 1 | 2 | 3 | 4 | 5 |

129. ¿Qué tan seguro está usted de que la **Policía Municipal o la Policía del Estado** pueda responder y controlar un acto de violencia de los criminales?

| Nada Seguro | No muy seguro | Poco seguro | Muy seguro | Completamente seguro |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

130. ¿Qué tan seguro está usted de que la **Marina y Armada de México** pueda responder y controlar un acto de violencia de los criminales?

| Nada Seguro | No muy seguro | Poco seguro | Muy seguro | Completamente seguro |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

131. ¿Usted conoce a alguien que haya sido víctima de un crimen violento en los últimos 12 meses?
Si____, No____

En caso afirmativo, por favor seleccione de la tabla el tipo de delito y si hubo **violencia física**. (Seleccione todas las que apliquen)

| | **Robo de Auto** 1 | 2 | **Robo Personal** 3 | 4 | **Secuestro** 5 | 6 | **Extorción** 7 | 8 | **Homicidio** 9 |
|---|---|---|---|---|---|---|---|---|---|
| | Violencia | Sin Violencia | Violencia | Sin Violencia | Violencia | Sin Violencia | Violencia | Sin Violencia | |
| A)Conocido | | | | | | | | | |
| B)Amigo | | | | | | | | | |
| C)Pariente | | | | | | | | | |
| D)Familiar | | | | | | | | | |
| E)Yo mismo | | | | | | | | | ------------- |

132. ¿Qué tan preocupado está usted acerca de su seguridad y la de su familia?

| No estoy preocupado | No muy preocupado | Un poco preocupado | Muy preocupado | Demasiado preocupado |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

133. ¿Siente que usted o su familia pueda ser víctima de los siguientes crímenes en los próximos 12 meses?

| | 1<br>No, nada probable | 2<br>Muy poco probable | 3<br>Probable | 4<br>Muy probable | 5<br>Si, totalmente |
|---|---|---|---|---|---|
| A) Robo de Auto | | | | | |
| B) Robo Personal | | | | | |
| C) Extorcion | | | | | |
| D) Secuestro | | | | | |
| E) Homicidio | | | | | |
| F) Agresion Fisica | | | | | |

134. ¿Cuánto **teme / que tanto miedo tiene usted** ser víctima de los siguientes delitos en los próximos 12 meses?

| | No temo nada | Temo poco | Tengo temor | Temo mucho | Temo demasiado |
|---|---|---|---|---|---|
| A) Robo de Auto | 1 | 2 | 3 | 4 | 5 |
| B) Robo Personal | 1 | 2 | 3 | 4 | 5 |
| C) Extorcion | 1 | 2 | 3 | 4 | 5 |
| D) Secuestro | 1 | 2 | 3 | 4 | 5 |
| E) Homicidio | 1 | 2 | 3 | 4 | 5 |
| F) Agresion Fisica | 1 | 2 | 3 | 4 | 5 |

135. ¿Cuánto **teme / que tanto miedo tiene** usted **que su familia** sea víctima de los siguientes delitos en los próximos 12 meses?

| | No temo nada | Temo poco | Tengo temor | Temo mucho | Temo demasiado |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| A) Robo de Auto | 1 | 2 | 3 | 4 | 5 |
| B) Robo Personal | 1 | 2 | 3 | 4 | 5 |
| C) Extorcion | 1 | 2 | 3 | 4 | 5 |
| D) Secuestro | 1 | 2 | 3 | 4 | 5 |
| E) Homicidio | 1 | 2 | 3 | 4 | 5 |
| F) Agresion Fisica | 1 | 2 | 3 | 4 | 5 |

136. ¿Cómo percibe el riesgo de que usted o su familia sea víctima de un crimen o asalto violento comparado con otras familias de su comunidad o ciudad?

| Mucho menor riesgo | Menor riesgo | Igual | Mayor riesgo | Mucho mayor |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

137. En comparación con el resto de las familias de su comunidad o ciudad, ¿Cómo cree usted que **su familia es percibida** en cuanto a los siguientes aspectos?

| | Mucho menos | Poco menos | Igual | Poco mas | Mucho mas |
|---|---|---|---|---|---|
| A)Rica (propiedades) | 1 | 2 | 3 | 4 | 5 |
| B)Vulnerable | 1 | 2 | 3 | 4 | 5 |
| C)Socialmente Activa | 1 | 2 | 3 | 4 | 5 |
| D)Rica (efectivo) | 1 | 2 | 3 | 4 | 5 |
| E)Con influencias | 1 | 2 | 3 | 4 | 5 |

Voy a leer algunas declaraciones acerca de la violencia. Por favor, indique qué tan de acuerdo o en desacuerdo esta con cada declaración. **Las respuestas van del 1 a 5**.
**1 = Totalmente en desacuerdo (NO), 2 = Poco de acuerdo, 3 = Mas o menos de acuerdo, 4 = De acuerdo, 5= Totalmente de acuerdo (SI)**
SI NO SABE O PREFIERE NO RESPONDER POR FAVOR INDIQUELO.
Por favor escriba en la línea el número del 1 a 5 de acuerdo con su nivel de acuerdo o desacuerdo.

138. Si soy detenido por un criminal, lo cierto es que yo muera.________
139. Hay cosas que puedo hacer para evitar ser asesinado por criminales.________
140. Si estoy siendo extorsionado por un criminal, puedo vender mi finca e irme a otra zona a comprar otra finca. ____
141. Una balacera deliberada por los criminales en la ciudad puede matar a mucha gente inocente.__
142. Vivir en una región donde el crimen es común es un nuevo tipo de riesgo para mi._______
143. El Ejército Mexicano puede identificar dónde están los criminales ubicados.________
144. Yo sé sobre el modo de operación de la criminales._______
145. Los crímenes de las actividades de los criminales puede ser controlada._______
146. La presencia de criminales en mi región puede poner en peligro futuras generaciones.________
147. Debido a que trabajo en una finca, personalmente estoy en una situación de riesgo por la presencia de criminales en mi región.______
148. Debido a que transito en las carreteras locales, personalmente estoy en una situación de riesgo por la presencia de criminales en mi región.______
149. La presencia generalizada de los criminales en el país puede causar una catástrofe nacional._____
150. Cuando los criminales cometen crímenes violentos, el Ejército Mexicano puede reaccionar con rapidez para evitar una catástrofe mayor.______
151. El riesgo de que me secuestren los criminales está aumentando.________

152. El riesgo de que me secuestren los criminales puede ser fácilmente reducido________
153. El riesgo de que me roben los criminales está aumentando.________
154. El riesgo de que me roben los criminales puede ser fácilmente reducido.________
155. Yo puedo minimizar el riesgo de ser víctima de un crimen.________

156. ¿Ha considerado mudarse a otra ciudad debido al riesgo de ser víctima de crímenes violentos?

| Nunca | Pocas veces | Algunas veces | Muchas veces | Todo el tiempo |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

157. ¿Conoce a alguien que se ha mudado a otra comunidad o ciudad debido al temor de ser víctima de los narcos? Si____, No_____

A). En caso afirmativo, ¿cuál es su relación con ellos?
1). Conocido______, 2). Amigo______, 3). Pariente______, 4). Familia_____

158. ¿Ha cambiado sus decisiones de producción en su finca debido al riesgo de la violencia?
Si___, No____
159. ¿Ha cambiado sus actividades diarias debido al riesgo de la violencia? Si____, No___
160. Si el nivel actual de la violencia continúa, cambiará sus decisiones de producción en su finca?
Si___, No___
161. Por favor, indique la importancia de los siguientes factores en sus decisiones de producción.

| Factores | Nada Importante | | | Indiferente | | | Demasiado Importante |
|---|---|---|---|---|---|---|---|
| A) Sequías | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| B) Huracanes | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| C) Precio de venta de cultivos | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| D) Precios de insumos | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| E) Programas de gobierno | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| F) Producción por hectárea | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| G) Violencia de narcos | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| H) Robo de coche | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

162. ¿Es usted socio de Interagro de las Huastecas?
Si_____, No_____

**Para ser respondidas solamente por el entrevistador**
a) En su opinión, el entrevistado estaba interesado en el estudio y respondió con sinceridad a todas las preguntas?
1) Total desacuerdo____, 2) Poco de acuerdo___, 3) Más o menos de acuerdo_____,
4) De Acuerdo___, 5) Totalmente de acuerdo_____

b) En su opinión la calidad de las respuestas dadas en esta encuesta es el adecuado para incluir en los informes escritos.

1) Total desacuerdo____,   2) Poco de acuerdo___,   3) Más o menos de acuerdo_____,
4) De Acuerdo___, 5) Totalmente de acuerdo_____
Por favor escriba cualquier otro comentario aquí:
Muchas gracias por participar en esta encuesta.